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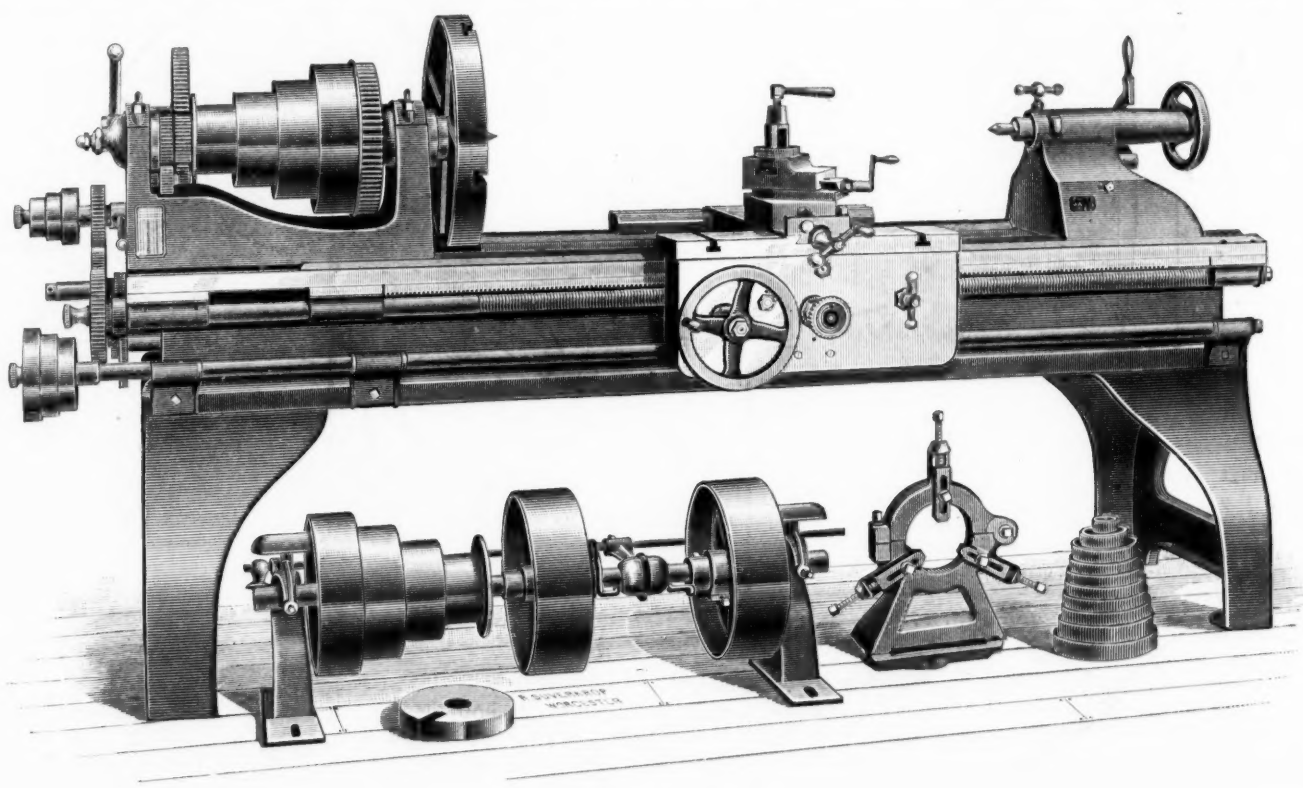
20 in. Engine Lathe.

We illustrate herewith a new design of engine lathe, recently brought out by McMahon & Co., of Worcester, Mass.

As the cut shows, the design is of a substantial character, and the lathe is intended to do the heaviest work within its capacity. Large cones, having wide belt faces and powerful gearing give it ample driving strength for taking heavy cuts. The spindle is made of crucible steel, and is supported in large and heavy boxes.

The carriage has a long bearing upon, and is gibbed to the bed front and back, its full length, and may be provided with any one of three different styles of rests, viz., compound, as shown in cut, patent adjustable, or plain gibbed, and with any of them will face up to the full swing of the lathe. The longitudinal and cross-feeds are both operated by a single milled button, which, when turned to the right, engages the longitudinal, and to the left, the cross-feed.



20 INCH ENGINE LATHE.

Both the feed rod and lead screw are provided with three bearings. The lead screw and change gears are used for screw cutting only, and will cut from 2 to 24 threads to the inch. The intermediate gear, which answers for all changes, is used for this purpose only, has a long bearing on the stud, and need not be removed in making changes.

The feed cones are so arranged and proportioned that they can be changed without the use of a wrench from stud to feed rod, and *vice versa*, thus securing six uniform changes of feed, instead of three.

The tail stock is released from, and firmly fastened to, the bed by a single movement of a lever, which is pushed from and drawn towards the operator.

A new method is also employed for clamping the tail spindle, by which the sawing open of the tail spindle bearing is avoided, and its strength and truth left unimpaired.

A single wrench answers for all parts of the lathe. They are provided with large and small face plates, center rest, and patent friction countershaft, having 14″ pulleys with 4″ face. The lathe swings 20″ over the bed, 14″ over the carriage. With 8 feet bed it takes 4 feet between centers, and can be made any desired length.

For further information the makers may be addressed as above.

At this time of writing, the prospects for business in the direction of machinery manufacturing have not been better for years.

The Use of Wrought-Iron and Rolled-Steel Bars and Plates in Large Engine Bed Plates.

BY W. H. HOFFMAN.

Wrought-iron and steel has never been extensively used in the construction of uprights and bed plates for large engines. Many yacht engines, and some land portables, have rolled-iron, either round or flat, for their engine frames. One of the English torpedo-boat builders has a design for a plate-steel frame, or set of uprights, formed or moulded to the shape required on a cast-iron former. This builder first experimented with this style of frame by building a small compound yacht engine, with cylinders 12″ and 20″ diameter by 15″ stroke. With this stroke, the engine frame proved to be rigid enough for the service, but when the stroke was lengthened to 24″ and 28″, the wrought-plate frames were too elastic, and caused the cross-heads, pins, and guides to heat. The wrought-iron and steel columns used in marine engines have given the best results next to cast-iron, the latter metal being considered the best on account of its stiffness.

Small marine engines, however, must be made as light as possible, and some are now produced that weigh less than 28 pounds per horse power. These engine frames are mostly made of round and square steel bars, the steam cylinders ranging from 10″ and 18″ × 15″ stroke to 14″ and 26″ × 20″ stroke. The cast-iron cylinders are not more than $\frac{3}{4}$ of an inch thick at any point. These engines run at very high speeds. Though wrought metals often appear in the upright portion of a marine engine frame, they have rarely been used in the lower bed plates, great or small. The reason advanced for not using rolled and forged metals in the bed plates, has been the same as that used against the plate metal uprights, viz., a general lack of rigidity.

While this reason holds good on an engine upright of large proportions, it does not prove that wrought metals must be entirely excluded in the design and construction of large engine bed plates. The bed plate of an engine, either marine or stationary, has the advantage of being reinforced by the heavy engine keelsons in marine service, and heavy stone foundations in stationary service. On the other hand, the uprights, or frames, of a vertical engine must rely on their own rigidity to resist the various strains of the engine, caused by pressures, and the rolling of the ship.

Heavy engine bed plates are now as a rule entirely of cast-iron, sometimes made in sections for convenience in casting and erecting, but are frequently cast in one piece, and some of the latter class are of enormous weight.

To reduce this great weight, the writer has prepared designs, which introduce either steel or iron, rolled-plates and bars, in combination with a cast-iron frame or skeleton bed. The top and bottom flanges are sufficiently heavy for the bolting of the uprights, though not as heavy as the usual practice, for the reason that all the main upright bolts pass through the entire depth of the bed.

The central cross webs of the bed plate, that support the main crank shaft, are made comparatively light in the cast-iron portion, and are then reinforced by rectangular steel bars, that are shrunk on to the main casting, suitable lugs being cast on to receive them.

If the bed is sectional, the parts are bolted together by the methods now in use.

For our American beam engines, and large horizontal pumping and blowing engines, I introduce the double stem riveted girder beam, with cross ties between the two double sides, these ties being made of cast-iron with planed ends, and bolted through from side to side. The top flanges are of cast-iron, but the bottom flanges are of rolled channel iron, riveted between the two side stems. Distance thimbles are used when necessary.

In large stationary engine work, the system suggested offers many advantages.

A long and heavy bed plate is many times inconvenient to mould, and then we are not sure of the casting until it has been stripped of the moulding sand, and thoroughly examined.

The wrought-girder system removes all risks, as the cast-iron top flanges are simple channel-shaped pieces, made in one or more sections, according to length. For a beam engine, we should make the uprights or gallows frames on the same plan, the edge plates being of cast channel pieces, with central tie girts of cast-iron in both directions. One of the other advantages in this system is in their transportation and erection, as in very heavy work the sections can be riveted together on their foundations. Then again, these bed plates and frames are not liable to breakage in handling or by sudden shocks from water concussion, and other well-known causes of fracture. From the writer's experience in the use of rolled wrought-iron and steel, he is satisfied that the introduction or addition of a small amount of cast-iron, as a stiffener, gives a structure for mechanical purposes that is far superior to the casting alone.

For a beam pumping engine, we should extend the wrought-plate system to the beam itself. There are many wrought-plate beams in use at present, but few, if any, are designed to use the cast-iron portions simply as stiffeners.

The wrought-iron or steel beam should consist of four, instead of the usual two side plates or central stems, each stem being riveted to cast-iron stiffening flanges and central bracing cross ties. No forged beam strap, with a rectangular or square cross section, containing from 30 to 80 square inches, can be as strong as a wrought-iron or steel beam composed of plates or stems from $\frac{3}{8}$″ to $\frac{3}{4}$″ thick.

An English engine builder has just patented a system for making laminated wrought-iron and steel engine cranks, because the thick, solid forgings are so liable to break. The heavy solid crank is only sound and reliable in about 65 to 75 per cent. of its cross section, and in many cases

where large marine engine cranks have broken at sea, there was less than one-half of the section fit for work. The laminated crank is made of wrought-iron or steel plates from $\frac{3}{4}''$ to 3″ in thickness, according to the size of the crank. These plates are bored accurately, then pressed and keyed on to the shafts and crank pins. The inventor claims that his system offers a perfectly sound crank, and says that any undue strain can always be detected by the buckling of one or more of the plates. I believe this method of building up heavy cranks will prove to be successful, if care is used in fastening them to the shafts and pins.

Large masses of cast metal should always be avoided in steam engine construction, as they occupy unnecessary space, present objectionable weight, and are very unreliable when subjected to heavy work, and in considering the forged metals, experience teaches us that similar masses of these are almost as treacherous as the castings.

The portion of a marine engine bed plate surrounding three sides of the crank shaft, usually has a superfluous amount of cast-iron which can be entirely dispensed with in the combination system. There will be no heavy lugs for the cap bolts, as these will pass down on the outsides of the skeleton webs, the caps being of steel or wrought-iron forgings. The caps then for each bearing will be simply two steel or wrought straps, with a space between them through which the top box can always be examined in case of heating.

Stone breaking and ore crushing machinery has been made of cast-iron, reinforced with forgings, for the past twenty years; therefore the system is not new and experimental, but old and well tried, and it is to be hoped that it will be more generally adopted by the builders of heavy steam machinery.

Modern Locomotive Construction.

By J. G. A. Meyer.

SIXTIETH PAPER.

Counterbalance, continued.

So far we have assumed that the center of gravity of the crank and the center of gravity of the counterbalance lie in one straight line passing through the center of axle. We have also stated that the length of the lever arm of the counterbalance is equal to the distance between the center of the axle and the center of gravity of the counterbalance. It is now to be explained how the position of the center of gravity of the counterbalance, or, in other words, the distance between the center of gravity of the counterbalance and the center of axle, can be determined.

Let the full lines in Figs 374 and 375 represent two views of a counterbalance weight; it is required to find the distance between its center of gravity and center of the axle; the arc $f\,b\,g$ is described from the center of the axle, and the radius is 11 inches. The middle point b of the arc $f\,b\,g$, the center of gravity of weight, and the center of axle are to lie in one straight line.

From the conditions given we know that the distance from the point b to the center of axle is 11 inches, it therefore remains to find only the distance between b and the center of gravity of the weight.

Fig. 375 shows that the thickness of the weight is the same throughout; we have, therefore, two methods for finding the position of its center of gravity, first, a geometrical method; and second, a practical method.

Geometrical Method.—For the purpose of finding the distance between the center of gravity and the point b when the thickness of the weight is uniform we have only to find the center of gravity of the surface or plane $e\,a\,d\,g\,b\,f$, Fig. 374.

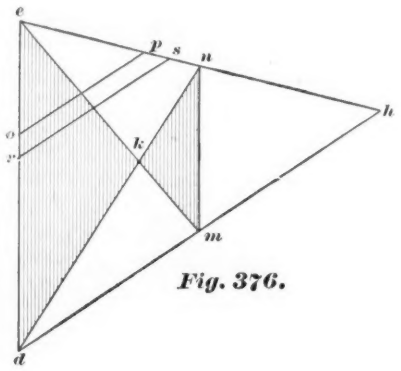


Fig. 376.

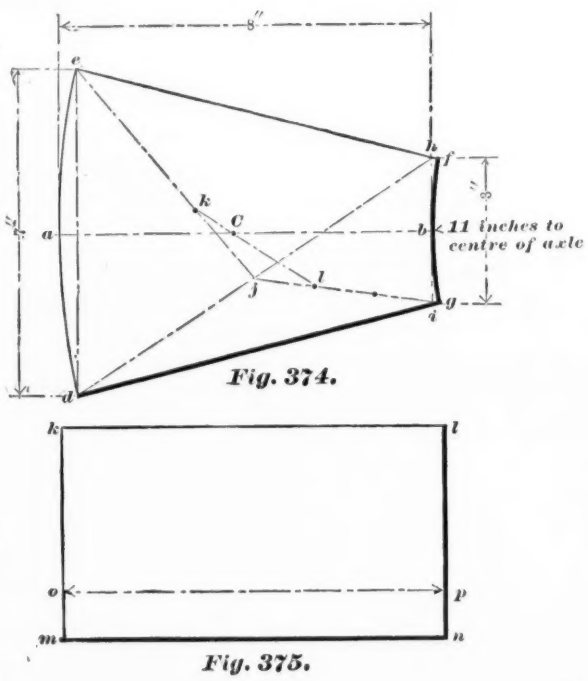


Fig. 374. Fig. 375.

Fig. 374. Join the points e and d by a straight line, and bisect this line by the perpendicular line $a\,b$, cutting the arc $f\,g$ in the point b. The line $a\,b$ will divide the plane $e\,a\,d\,g\,b\,f$ into two equal parts, the line $a\,b$ is therefore a center line; it also contains the center of gravity of the plane, because it passes through the centers of all lines drawn parallel to the line $e\,d$. Through the point b draw a line $h\,i$ perpendicular to $a\,b$, cutting the line $e\,f$ in the point h, and the line $d\,g$ in the point i. For the sake of simplicity we will now consider the plane to be bounded at the ends by the straight lines $e\,d$ and $h\,i$ in place of the arcs $e\,a\,d$ and $f\,b\,g$. Join the points d and h by a straight line $d\,h$, bisect this line, that is, find the point j midway between the points d and h; join the points j and e, also the points j and g, by the straight lines $e\,j$ and $j\,g$. Divide the line $e\,j$ into three equal parts, and thus obtain the point k, which is the first point of division from the line $d\,h$. Also divide the line $j\,g$ into three equal parts, and thereby obtaining the point l, which is the first point of division from the line $d\,h$. Join the points k and l by a straight line $k\,l$ cutting the line $a\,b$ in the point C; this point C will be the center of gravity of the plane $e\,d\,h\,i$; that is, the center of gravity of the plane bounded by the straight lines $e\,d$, $h\,i$, $e\,h$, and $d\,i$; and will not be the exact center of gravity of the plane bounded at the ends by the arcs $e\,a\,d$ and $f\,l\,g$; but for all practical purposes we may consider the point C to be also the center of gravity of the plane bounded by the arcs, as in this case the error will not amount to more than $\frac{1}{8}$ of an inch; that is to say, the distance between the point a in the arc $e\,a\,g$ and the center of gravity C found by the foregoing construction, will only be $\frac{1}{8}$ of an inch greater than the distance between a and the true center of gravity of the plane bounded by the arc $e\,a\,d$ and $f\,b\,g$.

To prove that the point C is the correct center of gravity of the plane $e\,d\,h\,i$, it may be stated that the line $d\,h$ divides the plane into two triangles, $d\,e\,h$ and $d\,h\,i$; the point k is the center of gravity of the triangle $d\,e\,h$, and the point l is the center of gravity of the triangle $d\,h\,i$. We may now consider the two triangles to form a system of bodies; under these conditions the point about which the two triangles will balance each other must lie in a line joining the centers of gravity k and l; but the two triangles make up the plane $d\,e\,h\,i$, and we have seen that the center of gravity of this plane must lie in the center line $a\,b$, therefore its center of gravity C must be the point in which the lines $a\,b$ and $k\,l$ intersect.

To show that the method of finding the centers of gravity k and l of the triangles is correct, we have the following demonstration, taken from "Theoretical Mechanics," by J. Weisbach.

In a triangle $d\,e\,h$, Fig. 376, every line drawn from an angle to the center of the opposite side will contain the center of gravity of the triangle. Thus the line $e\,m$ drawn from the angle e to the center m of the opposite side $d\,h$ will contain the center of gravity, because the line $e\,m$ bisects all lines such as $o\,p$, $r\,s$, which are drawn parallel to the side $d\,h$. The line $d\,n$ drawn from the angle d to the center n of the opposite side $e\,h$ will also contain the center of gravity of the triangle, because the line $d\,n$ will bisect every line drawn parallel to the side $e\,h$, and therefore the point of intersection k of the two lines $e\,m$ and $d\,n$ must be the center of gravity of the whole triangle.

Join the points n and m by a straight line; this line $m\,n$ must be parallel to the side $e\,d$, because the line $m\,n$ is drawn from the center of the side $e\,h$ to the center of the side $d\,h$. Again, the length of the line $n\,m$ must be equal to one-half of the length of the side $d\,e$, because the line $n\,m$ is drawn from the center n of the side $e\,h$ parallel to $e\,h$. Since $n\,m$ is parallel to $d\,e$ it follows that the triangles $m\,n\,k$ and $d\,e\,k$ are similar; and because $m\,n$ is equal to one-half of $e\,h$, the line $m\,k$ is equal to one-half of the line $e\,k$, and consequently the line $k\,m$ must be equal to one-third of the whole line $e\,m$. Hence the center of gravity k of the triangle $d\,e\,h$ is at a distance equal to $\frac{1}{3}\,e\,m$ from the middle point m of the side $d\,h$, and at a distance equal to $\frac{2}{3}\,em$ from the angle e.

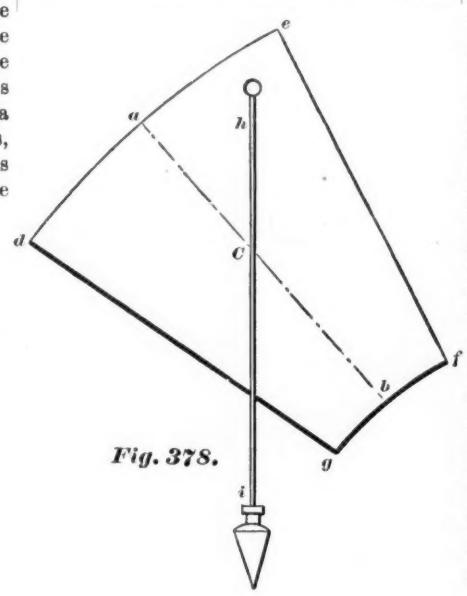


Fig. 378.

Practical Method.—Before the practical method for determining the center of gravity is explained, let us first obtain an insight into an important property of gravity. Let the outline in Fig. 377 represent the shape of an iron plate of equal thickness throughout, and let A, B, C and D represent holes drilled anywhere near the edges of this plate. Assume now that from a pin driven into a wall the plate is suspended by the hole A, the diameter of the pin being a little less than that of the hole, so that the plate can freely turn on the pin. We now find that after the plate has made a few oscillations, it will come to rest in only one position, even if we withdraw it from this position, the plate, as soon as it is free to move, will again come to rest in the same place. Let us carefully mark this position; to do so, we suspend a chalked line $h\,i$, and plummet from the pin; then, when the plate is at rest, we carefully snap the string against the plate and thus obtain on the plate a chalked mark which represents a vertical line drawn through the center of the hole A. We now remove the plummet and suspend the plate by the hole B, then replacing the plummet we draw on the plate in the same manner as before another vertical chalked line through the center of the hole B. In a similar manner we suspend the plate, in succession, from the holes C and D, and from the center of these holes draw vertical chalked lines, thereby obtaining four chalked lines, which are represented in the figure by broken lines drawn through the centers of the holes $A\,B\,C$ and D. We now find this remarkable circumstance, namely, all these lines will intersect in one and the same point G. If additional holes E, F and H are drilled anywhere in the plate—near its edges—and the plate suspended from these holes in succession, and chalked lines drawn in a manner as described, we will find that these additional lines through the centers of the holes E, F and H will also pass through the same point G. This point is the center of gravity of the plate. Hence we may say that a vertical line drawn through the point from which the plate is suspended will pass through, or contain the center of gravity of the plate. The lines which pass through the center of gravity of a body are called "lines of gravity."

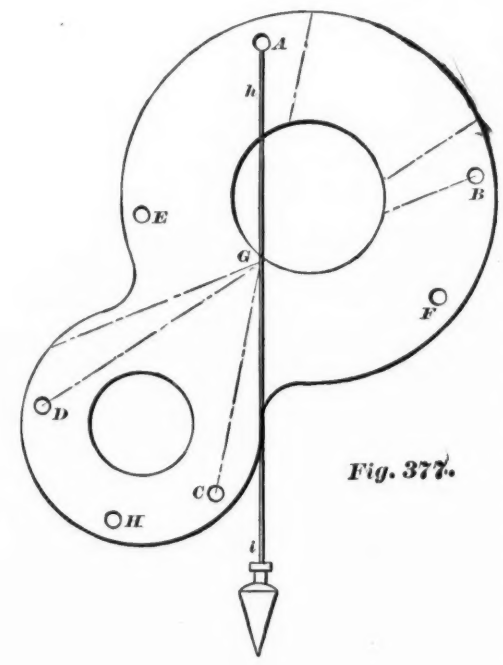


Fig. 377.

In precisely the same manner we can find the position of the center of gravity of the weight shown in Fig. 374, thus: Cut a templet to the form of the surface shown in Fig. 374. When the templet is to be cut to full size, it will be best to make it of wood; the thickness of the templet must be the same throughout; indeed, this condition is very important; the amount of thickness makes no difference; it may either be $\frac{1}{8}$ or $\frac{1}{4}$ of an inch, or an inch, but the thickness of the templet must be uniform. When the templet is to cut to a scale, it may be made of stiff paper; in this case care must be taken to keep it perfectly flat.

On this templet draw the center line $a\,b$; this line will contain the center of gravity of the surface shown in Fig. 374. Anywhere in, and near one of the corners of the templet, punch a small smooth hole, and from a pin suspend the templet by the hole, as shown in Fig. 378. In doing so care must be taken to allow the templet perfect freedom to turn on the pin. From the same pin suspend a plummet line, and when the templet is at rest mark off the point C in which the plummet line intersects the center line $a\,b$; this point C will be the center of gravity of the surface shown in the figure, and will give the distance

between the center of gravity of the weight and the point b, which is equal to $4\frac{1}{2}$ inches. Therefore the distance between the center of axle and the center of gravity of this counterbalance weight is equal to $11+4\frac{1}{2}=15\frac{1}{2}$ inches. Or, we may say, the lever arm of the counterbalance is $15\frac{1}{2}$ inches long.

Robertson's Damper Regulator.

We scarcely need remind our readers of the advantages to be derived from the use of a damper regulator, provided only that a thoroughly efficient and reliable one is to be obtained—the saving in fuel, by the prevention of safety-valve opening and consequent waste of steam, and the increased wear and tear due to frequent and excessive changes in steam pressure and temperature, being well understood.

The especial points of merit claimed by the makers for the regulator, which we illustrate herewith, are the absence of springs or diaphragms acted upon by steam, and the fact that the damper is closed positively by the steam pressure and opened by a weight, instead of the reverse.

By this means, it is claimed that all danger of excessive steam pressure resulting from a failure of the weight to close the damper is avoided. If, for any reason, the weight fails to work the damper, it simply remains closed, and no dangerous results can follow.

In operation, steam enters at H, Fig. 1, all condensation and sediment falling into chamber I, from whence it can be drawn off through the valve and pipe below. The steam pressure acts constantly upon the cylindrical valve A, which is held down by the lever and weight M.

Whenever the pressure rises sufficiently to force the valve A upwards, the lower opening of the port L is uncovered, and, at the same time, the upper opening is brought into communication with the lower groove or port which is turned in valve A. Steam then flows through the pipe S into cylinder C, forcing the piston B down and closing the damper. The pressure which is sufficient to do this of course depends upon the position of the weight upon the lever. The screw U, above the lever, can also be set to determine the height to which the lever shall rise, and consequently, the amount of opening of the port; so that a quick or slow movement may be secured, as desired.

When the pressure has fallen sufficiently, the valve A descends until the upper port is opened and the lower one closed, the steam in the cylinder C passing out through F' into the atmosphere, allowing the weight to open the damper. A small opening is provided in B, through which condensation escapes. They are constructed of steam metal, with anti-corrosive valves, and present a very neat appearance.

For marine boilers or other purposes where the lever and weight might not work satisfactorily, they are provided with a spiral spring instead, as shown in Fig. 3.

It will be noticed that the construction admits of the working parts being easily removed in case it is desired to do so.

These regulators are made by Hine & Robertson, 45 Cortlandt street, New York city.

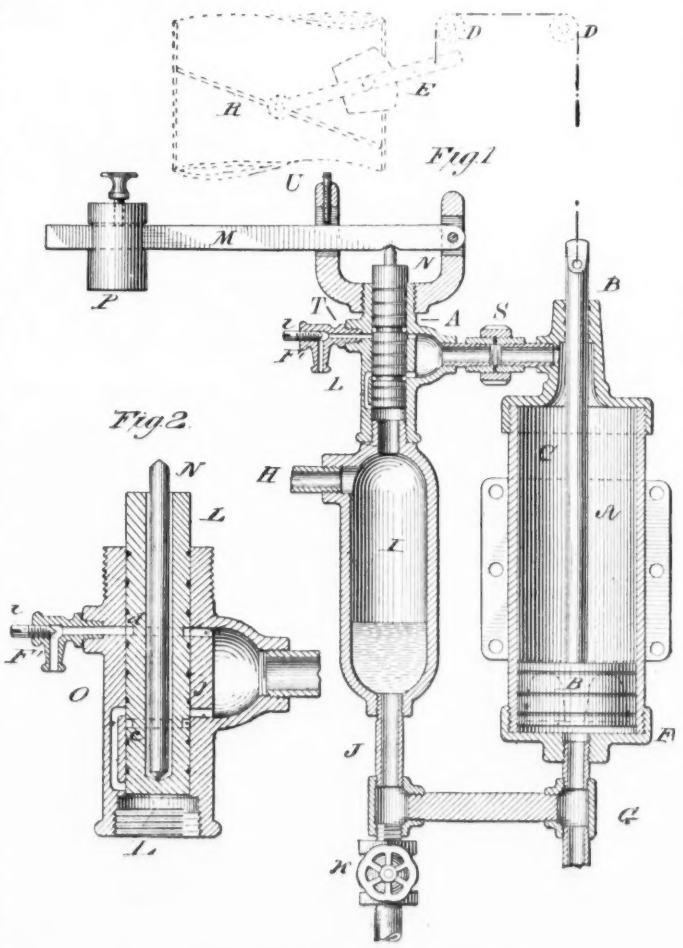
Milling Versus Planing.

Referring to Mr. John Grant's criticism, which we publish elsewhere in this issue, we are aware that it is a common practice to compute shop expenses at a certain percentage of the cost of labor, and have not denied the propriety of so doing in making invoices, or computing the cost of jobs requiring for their completion various kinds of labor, so that the work done upon them comes near being representative of the general character of the work done in that shop.

The question is asked by Mr. Grant, "Is it fair to charge the same expense account for a boy earning from fifty cents to one dollar per day as to the man earning from $2.50 to $3.50 per day?" Our answer is, that it depends upon circumstances, and that sometimes it may be entirely fair to charge for the boy a much larger expense account.

A high-priced mechanic may be employed upon work which requires him to use only a vise and some chisels and files, aside from his own kit, while a cheap boy may, as Mr. Grant says, run six milling machines, worth $3,000. The term shop expenses, when used in connection with the estimation of the cost of work, includes cost of power, interest on investment in machinery and plant, repairs to machinery and plant, and depreciation in value of the same, insurance, supervision, clerk hire, supplies for general shop use, etc. For no one of these items is the expense any less for the boy using six milling machines than for the man using no machine of any kind, and for most of them it is plainly much heavier.

We do not think that in such a case it would be fair to charge for the man three times as much shop expenses as for the boy, simply because his wages were three times as much, especially when considering the comparative efficiency of the two, or of the tools used by them.



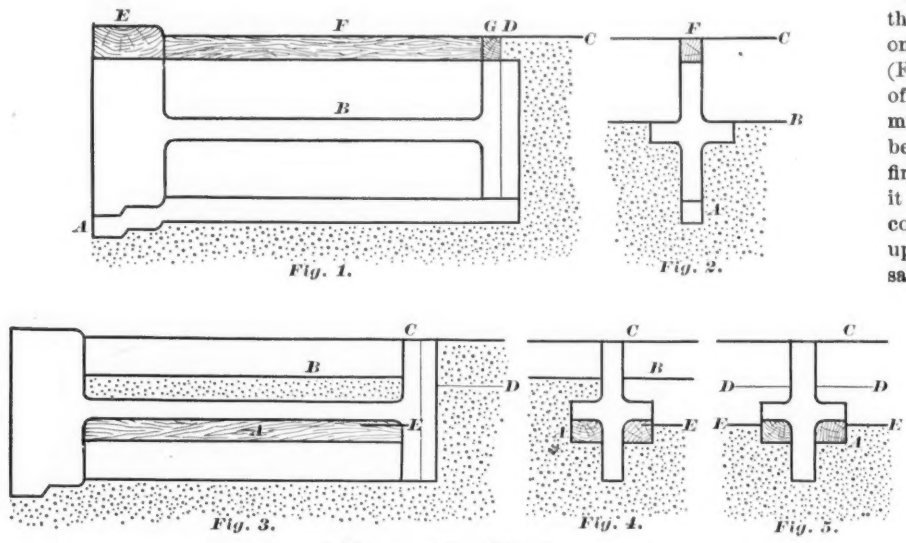
Robertson's Damper Regulator.

Spur Wheels of Different Depths from the Same Pattern.

By S. Bolland.

If a spur wheel should be required 6 feet diameter, 16 inch face, and we had a pattern on hand correct in every particular but depth, we should very naturally look about for some method of moulding it from such a pattern at as little cost as possible for alterations; and whilst there are many admirable methods for increasing the depth of spur wheels, I especially favor the one suggested in this article.

Suppose our pattern to be 12 inches deep, with center web fast in the arms, and suppose also that the wheel when cast must have the web still in the center. We can readily accomplish this by building one-half the difference on the top side of the pattern, which in this case is 2 inches, as seen at E F G, Fig. 1. It will not be necessary to cover the teeth with this addition; simply saw out a few segments to set on up to the inside of the rim.



Making Spur Wheels.

Figs. 1 and 2 will explain the way to mould from such a pattern. It will be seen at A in both views that the pattern (after being rammed up to the under side of web and round the outside) has been drawn up 2 inches and held there by firmly tucking the sand under the web. The ramming is then continued up to the upper side of web B, and also to the top of rim C.

After the cope is lifted off, the sand over the teeth at D can be taken away and the pattern again drawn up far enough to allow of the teeth being rammed level with the joint, after which the pattern can be drawn out and the mould finished in the regular manner.

But should it be required to decrease the depth 4 inches, which would make our wheel 8 inches instead of 16 inches deep, the method shown at Figs. 3, 4, and 5 will overcome the difficulty. It will be seen at A that one-half the difference (2 inches) has been attached to the under side of the web, thus making that side of the pattern correct. After bedding in the pattern thus prepared, make the parting inside the arms 2 inches above the web, as seen at B. (This is simply placing as much sand over the web as there is wood under it.) This is done by using a strickle made to rest on the top of the pattern and projecting down far enough to give the correct depth of sand over the web. The parting on the outside must be level with the top of pattern, as seen at C.

After this impression has been taken in the cope, two other strickles are needed, one to work round the outside down to D (Figs. 3 and 5), which will be 4 inches deep, of course. The other is for the inside, and must reach to E (Figs. 3, 4, and 5) and will be just 4 inches deeper than the strickle first used for the inside. After this is done it will be seen that the surfaces in the cope corresponding to C and B will now rest upon D and E, the difference being the same in both instances. In other words, B will exactly fit at E, because the distance from D to E corresponds with the lift in the cope.

Shop Notes.

By Jarno.

No. 4.

Steps in Planer Feed.

Some planers take too long steps in changing feed. Suppose the shortest step is .007 inch. This will do for some work. The next step to .014 inch amounts to a jump. When a planer cannot quite carry a chip, the next finer should be tried. The next finer, or the chip taken, should not be too fine.

A manufacturer of planers says that, in order to have the advantage of quick adjustments and short feed steps, the ratchet wheel must either be large or its teeth be small.

My acquaintance over the way says: "Do not have the finest down feed any too fine for nine jobs out of ten. Let the tenth job shift for itself. In shifting for itself, it will put life into the workman by inviting him to feed down by hand. During the lifetime of men now living, there is no hope that a workman will feed down with more than one tooth."

I get along pleasantly with my acquaintance because I can generally beat him in an argument. As he does not appear to be in his usual good humor this morning, I will say nothing to him.

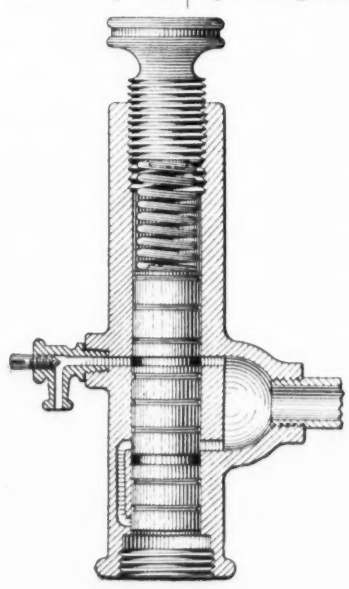


Fig. 3.

Let us have short steps in planer feed. If the workman is afraid of two teeth down feed, the maker of the planer may be to blame. Several workmen tell me that they often want more feed, but cannot take the next step because it is too long. The next workman I ask may justify the remarks of my acquaintance, but up to the present time the decision is for shorter feed steps. We cannot, by machinery, make men do the right thing. The average workman is not one who wants "plenty of stock and no size."

Suppose we let the finest feed be .0025 inch. The next steps will then bring the feed to respectively, .005 inch, .0075 inch, .01 inch, .0125 inch. Now a feed so fine as .0025 inch will hardly be needed. Yet this step makes a difference of twenty-five per cent. between .01 inch and .0125 inch. Although this fine .0025 inch feed is not needed, the short step will be a long step towards getting what a planer can give.

Other things being equal, the maker who puts short feed steps in his planers will be the one who wins in the race of competition.

Pattern Making Requirements.

By Wm. Hultgran.

In the selection of material that will be proper for different kinds of patterns, forethought and good judgment must be exercised. Pine has for many reasons, including the facility with which it can be worked, been almost universally adopted for patterns of such size and shape that the strength and durability attainable by its use will be sufficient. It should be the very best in quality, straight-grained, soft, and free from knots, to secure the best results when operated upon. Mahogany, from its greater strength and its resistance to decay, is adapted to light or delicate work. Cherry commends itself by its strength, but when compared with mahogany its value for patterns is less, as it is more liable to warp. Maple, although being somewhat hard on the edge of tools, and hence rather difficult to manipulate, may be used to advantage, especially so for patterns that are to be in constant use, and that are, as a matter of economy, too large to construct entirely of hard wood. In this case the body of the pattern may be made of pine, and the harder wood used in such parts or portions of pattern as are the most exposed to rough handling in the foundry, such as flanges and lugs or projections of any kind, and in the corners of patterns which would, if made of pine, soon be worn off, and thus produce a casting that would have anything but a neat appearance.

The storage of lumber should be such as to expose it to a free circulation of air. This can be accomplished in various ways; for instance, by erecting a rack in a convenient part of the shop, something like Fig. 1, material to be placed edgewise, as it will, in that position, be more liable to keep straight. Then, to supply the necessary space for circulation of air, and to hold each board or plank in the manner named, it is provided with perpendicular strips as seen, nailed fast such distances apart as will permit the easy introduction of material. Or an overhead arrangement may be made by suspending bars or beams on rods from joints of ceiling, as in Fig. 2, and providing it with the strips as shown, same as in Fig. 1, and for the same purpose. These methods commend themselves by the facility with which the pattern maker can measure the thickness of material and take down for use any desired board or plank that he may choose.

Under no circumstances should lumber for patterns be piled in such a manner as to allow the sides to be in contact, as it will in a case of that kind never properly season, and as lumber expands and contracts transversely to the direction in which the grain runs (that taking place longitudinally not being enough to make any practical difference) and according to the amount of moisture that it or the atmosphere contains, it will, in drying or in evaporating its moisture, contract, and should moisture in the air exceed that of the lumber, an absorption of moisture, or dampness will take place, causing it to expand. This latter tendency will be augmented if the material has gone through a process known as kiln drying.

Assuming, then, that two boards be placed one on top of the other, the upper surface of the top board being exposed, would, as a consequence, be subject to either evaporation or absorption of moisture; then in drying it would contract and cause the board to warp, as shown in Fig. 4, and in taking up moisture it would expand and cause the board to assume a shape shown in Fig. 5. Furthermore, if the boards were allowed to remain undisturbed for a length of time, board No. 2 in Fig. 4 and Fig. 5 would behave in a similar manner to that on top, according to the amount of surface exposed by the curvature. Hence, if any number of boards be placed in a pile in the position named, it would, in a short time, present an end view as seen in Fig. 6 or Fig. 7, depending, of course, on conditions.

Again, let us suppose that a couple of boards be placed edgewise in immediate contact with one another, as in Fig. 8. Then, the sides in contact being protected thereby from atmospheric action, would, as far as such action is concerned, remain neutral, and the sides exposed would contract or expand, according to conditions previously explained, and the boards would, as a result, present either a concaved surface, as in Fig. 9, or a convexed surface, as per Fig. 10.

From the foregoing it will be perceived that the tendency of material to warp will remain the same after it has entered into the construction of patterns; and this being a fact, the operator must exercise his skill in building up the patterns so as to obviate the same, as it is imperative that the forms and dimensions should be exactly the same, or remain constant, as the pattern is being used from time to time. The best way must be ascertained in which to place the parts in the construction in regard to the grain of wood, so as to prevent it from warping after the pattern has been finished or has been used in the foundry; also the best way to place the different pieces of which the pattern is composed, so as to get the greatest possible strength to withstand the abuse to which it will be subjected—a matter of no small consideration.

The patterns must be protected from the attacks made upon them by the moisture contained in moulding sand, and from the effects of the so often too freely indulged in practice known among moulders as swabbing. For this purpose shellac varnish is admirably adapted, as by its use the pores of the wood are entirely closed or filled up, and by repeated applications, and sandpapering a surface is produced that is impervious to damp or water—that is smooth and slick—and to which moulding sand does not readily adhere.

This leads me to consider the difficulties, disadvantages and obstacles that the pattern maker has to contend with. In an art of such scope and variety of work as is presented in pattern making, a good share of natural intelligence is required. Inventive ingenuity, continuous study and careful observation of methods must constantly be practiced. Upon all sides we encounter evidence of the pattern maker's skill. In the manufacture of machinery, architectural work, ornaments, household effects and fixtures for various purposes too many to enumerate, the making of patterns is a factor of consequence, and one of the initial steps.

The construction of a pattern must be such that it will mould, and if the number of castings required is sufficient to pay for the labor, it should be finished up in good shape and be made to mould with the greatest possible facility. The production of castings being an object in common between the pattern maker and the moulder, it would be well, if circumstances will permit, when complicated work is contemplated, to consult the moulder in regard to the foundry *modus operandi*, as much information may be derived therefrom, not speaking about the time and labor that may be saved. But, as the pattern maker is often so situated as to make interviews with that intent impracticable—as, for instance, in the jobbing pattern shop, or in establishments having no foundry attached—he is often left to act entirely upon his own judgment and experience; he must, as a consequence, work independently; and, as the pattern maker is considered in that state, the writer must not be understood as ignoring the moulder or his art, as that is, in itself, a study of a lifetime. Mr. Thomas D. West has aptly remarked, in his "American Foundry Practice," that "no man ever fully learned the trade of the moulder," and the pattern maker must, as a matter of compulsion, have a knowledge of foundry practice, as the operations of the moulder are preconceived and many times determined by him. He should be his own counselor as whether to make a pattern in halves or not; if it is best to construct the pattern to mould this or that side in the cope, so as to obtain a sound casting, and if cores should be used or dispensed with. He must carefully consider the matter of cost—if the saving of labor in the pattern shop will be overbalanced by additional labor in the foundry or *vice versa*. He must be familiar with the changes that take place in going from a liquid to a solid state in the various kinds of metals for which the patterns are to be used.

The different strains of shrinkage, as they present themselves in accordance with the shape of the pattern, must be considered, and as the power of shrinkage is practically irresistible the aim should be to so construct the pattern that it will, as far as possible, comply with shrinkage demands. The forms and shapes adopted must be such that the strains developed may, to a certain degree, be averted. He must be acquainted with the treatment that the casting will receive in the machine shop; if it is to be finished in its entirety or in parts, so as to make the necessary allowance for finishing wherever it is required, and in certain cases the pattern maker must assist the machinist in his operations by providing the patterns for peculiarly shaped castings with lugs and projections, to facilitate chucking and centering in the lathe.

The rapid interpretation of plans or drawings is an accomplishment of much importance, that, generally speaking, few mechanics acquire. This talent the pattern maker should cultivate, and in this he must become proficient before he can lay any claim to skill. He should be somewhat of a draftsman, competent to make working detail drawings or off-hand sketches. This is particularly essential in the instance of small shops, when there is not enough of either drawing or pattern making to keep one man busy. In large shops the ability to quickly and correctly read drawings may be all that is absolutely essential. But a pattern maker who understands drawing will always be more likely to be in demand, and at better pay, than one who does not.

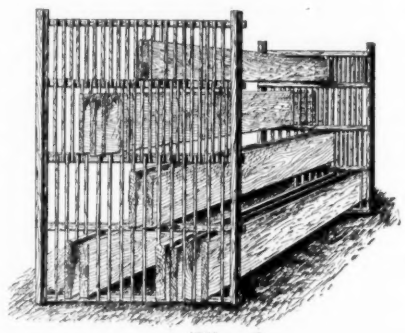


Fig. 1.

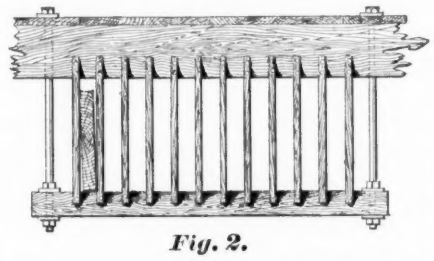


Fig. 2.

Fig. 4

Fig. 5

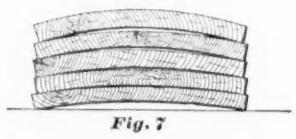


Fig. 7

Fig. 8

Fig. 9

Fig. 10

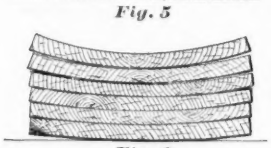


Fig. 6

Where Theory Was at Fault.

The recent publication, by one of our contemporaries, of a cut showing the position of two locomotives immediately after collision, when taken in connection with a cut published nearly eleven years ago by the same paper, and the editorial comments made upon it at that time, illustrate the uncertainty and unreliability of opinions and theories based upon anything short of actual knowledge of all the circumstances attending the case.

In the accident which occurred in 1876, the engines had come squarely together, and the front ends of both of them had been elevated, so that they both stood up on end, interlocked each with the other. It was not known at the time where the accident took place nor the circumstances attending it, but the editor sagely observed that "it doubtless occurred on a straight piece of line, or one or both engines would have been thrown from the track laterally," thus, with a stroke of the pen, apparently depriving the enginemen of the excuse that they were prevented from seeing each other by a curve. But this last accident, which occurred on the Erie road near Rochester, on January 17th last, took place, according to our contemporary, upon a sharp curve, and yet the cut shows the engines in almost precisely the same position, neither of them being thrown from the track laterally, nor so much as deflected towards one side or the other, thus practically demonstrating that the condition which it was supposed would surely produce a certain effect did not, when actually put to the test, produce any such effect.

The fallacy that lurks under the arguments in favor of wholesale technical instruction is shadowed in Professor Huxley's words—"The apprenticeship system has broken down." This, be it observed, is an opinion—not an established fact. The institutions which exist to promote industrial progress in this country all continue to recognize apprenticeship as the first qualification for admission into their respective corporations. Under the apprenticeship system, we have gained our present position in the industrial world. Already the opinion is gaining ground, among the most ardent advocates of forcible education, that the knowledge gained under the present elementary system savors "too much of books and too little of things." The next great discovery for them to make is that, under the scheme they now propose, the knowledge likely to be imparted will savor too much of a philosopher's closet and too little of a workshop. It may then dawn upon their imaginations that perhaps the best way to learn how to work well, for the serious business of life, is actually to engage in that work in the first instance. The development of principles can follow after.—*The Engineer* (London).

A recent article in a contemporary illustrates the mistakes of some who attempt to enlighten practical engineers in the mysteries of steam and steam-making. Having, apparently, read somewhere that a good steam engine utilized no more than one-tenth of the heat possibility of the fuel, this writer jumps to the conclusion that the loss is all in and about the boiler, and gravely argues that there is nothing remarkable in a loss of ninety per cent. of efficiency there.

Seventy per cent. of efficiency in a boiler is not uncommon, while as low as fifty per cent. except in exceptional cases would represent very good practice.—American Machinist.

Let us see: 90 per cent. loss, and the boiler loses only 30 per cent. Doesn't that throw a pretty big loss on the engine? We had thought our contemporary believed in better engine practice than this would seem to indicate.—*The Western Machinist and Woodworker.*

Yes, it does throw a pretty big loss on the engine, where it belongs. It will apparently astonish our contemporary to find, as it can by consulting any elementary work on the subject, that very much the greater part of the heat that goes into the cylinder of a steam engine goes out again with the exhaust.

The Engineer (London) says: "The American Society of Mechanical Engineers has just sent out a new list of members, officers, and rules. For some reason it has a size which is about an inch longer than the lists of any other society, and hence cannot go on the same shelf with others, and will be easily lost."

The Mason Diaphragm Valve.

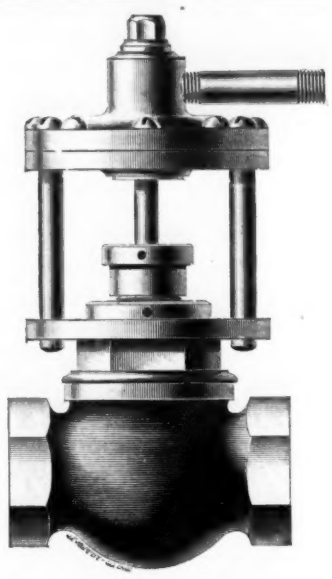
The accompanying cut shows a new valve for use in connection with automatic electric heat-regulating devices.

This valve takes the place of the ordinary globe valve in the steam supply pipe to the heating system. A thermostat is placed in the room, and has an electrical connection with any device to control the pressure, which is admitted through the small tube seen at the top of the valve.

Between the two upper plates is a diaphragm of phosphor bronze, to which the stem of the main valve is attached.

The pressure, which is controlled by the electric mechanism, is admitted through the inlet tube to the upper side of the diaphragm, thus forcing it down, and shutting off the supply from the system. The valve remains shut until the temperature of the room is sufficiently reduced to act upon the thermostat, when the pressure is removed from the diaphragm and the valve opens.

They are made of the best steam metal, in sizes ranging from $\frac{3}{4}$ to $1\frac{1}{4}$ inches, by The Mason Regulator Company, Boston, Mass.



DIAPHRAGM VALVE.

LETTERS FROM PRACTICAL MEN.

Answers to Criticisms on the Milling Machine and Drill Presses.

Editor American Machinist:

For several weeks I have kept quiet while reading the various criticisms on the paper read by me at the American Society of Mechanical Engineers' meeting held in Philadelphia last November on the milling machine as a substitute for the planer. Now, after reading the various articles, I have come to the conclusion that those who know the least about milling are the ones who are the most skeptical as to the desirability of using rotary cutters instead of the single pointed tool. As the returns seem to be about all in, I now propose to talk back.

To commence with, the editor seems to agree that milling is good in its place, but can hardly give up the planer. His *bete noir* seems to be in the shop expenses.

Now, is it fair to charge the same expense account for a boy earning from 50 cents to $1 per day as to the man earning from $2.50 to $3.50 per day? I have discussed the matter of shop expenses with a large number of owners and superintendents of shops, and find that the rule at the present time is to get the shop expenses into so much per cent. of the labor. If the shop expenses are put at so much per hour per man, the oiler who uses only his ladder and oil-can, the sweeper who uses a broom, and the blacksmith's helper who uses a sledge-hammer would be charged with as much expense per day as the high-priced skilled mechanic who uses only the best and most costly machines and the highest priced files and other small tools.

Another thing should have been taken into account and noticed in the paper, and that is, the boy attending the milling machines could have run four more on this class of work without overworking.

In the Feb. 11 issue F. L. Johnson quotes "Chordal" as saying, "An attempt to cut gearing on a planer will let the light in on the milling machine question." Now, I have the greatest respect for "Chordal" and his views on mechanical subjects, and being personally acquainted with him, know some of his peculiarities, and also know that there is nothing he enjoys more than a discussion on mechanical subjects. And I often used to think when reading some of his articles that some of the ideas advanced were for the purpose of starting a controversy. Certainly, if it is better to plane out gear and rack teeth, "what fools we mortals be" to waste our energies, time, and money to devise our elaborate gear and rack cutting engines, when we have the planer and shaper always handy, and about one-half hour's work would file up a tool for gear or rack cutting. I am afraid the quality of the gearing would deteriorate, and, as once remarked by a friend of mine when asked what kind of gearing they cut in a certain shop, his answer was, "Gearing! why it is simply notches on the periphery." Now, to refute the statements made by "Chordal," let me quote an extract from a letter received by me from the president of a large machine tool shop in relation to a large automatic rack cutting machine the writer designed for them:

"The rack cutter is doing splendidly, and you would be surprised to know the number of planers it is saving us, as you will remember we formerly cut all our racks on planers." Now, here is a case right to the point—a very large tool shop that was fitted with the best appliances on a planer to cut racks. There certainly should be a missionary sent to one place or the other.

Mr. Fred Holz, a man after my own heart, says in the Feb. 4 issue that he has seen 30,000 teeth cut in cast-iron wheels $\frac{3}{4}$" face, 10 pitch. "Grumbler" seems to think this gear cutting is something wonderful. If he will take the trouble, or would pay the expense, I could show him a cutter that has cut more than twice that number of teeth, and is good for several lots of gears yet.

The cut, Fig. 1, shows a sewing machine bed; the places *A*, *B*, and *C* are milled off. Fig. 2 shows the end of a roughing cutter, an exact copy of the one that has already milled about 28,000 of these beds, and has been ground but six times. The amount that has been worn off shows that without accident this cutter is capable of milling at least four times as many more before it becomes useless. This would make about 140,000 beds roughed and finished with one set of roughing and finishing cutters.

The young man who runs the two milling machines on which the beds are milled attends six more machines, taking different milling cuts, for which he receives $1.15 per 100 beds. Of course every fixture is made as handy as possible to clamp the beds for each different operation. Can "Grumbler" pick out any one of the different operations on this bed, he to have the same fixtures to use on a planer, and do it for the same price that is paid for every cut taken on it? I think not; and supposing that he could, would he agree to have them as near the gauge as they must be, and are, when done on the milling machine? Mr. Johnson speaks of the unfairness of the comparison of grinding milling cutters on a modern cutter grinder and the planer tools on a grindstone; or I should infer that that is what is meant. The only difference in the two cases is that the milling cutter cannot be accurately ground on the grindstone or emery wheel by hand, while the planer tool can, and in all my experience I have never yet seen any tool grinder with fancy attachments on which a man could grind a single point cutting tool for the lathe or planer as quickly as it could be done by hand on the modern water grinder, using an emery wheel.

Understand me, I am in favor of each and every handy appliance for use in the shop, no matter what it may be for; but, as we are now talking of the rapidity with which tools can be ground, and not the accuracy, I make the above statement, at the same time knowing that tools can be ground much better with the modern arrangements.

Mr. Johnson again remarks that he don't see the justice of paying a milling machine hand 9 cents per hour and the planer hand 25 cents per hour, and that a boy can learn to run one machine as quickly as another. Mr. Johnson has certainly not had much experience with the milling machine, or he would not have made the above statement.

The fact of the matter is that it requires a far more intelligent boy to run a planer than the milling machine. In using the planer it is necessary for the boy to learn to properly grind and set the cutting tools, and when you notice how few men there are, even those who are getting journeymen's wages, that can grind a tool properly, how can you expect any boy that you may pick up out of the street to be able to do so in a few hours?

In the next place, it is quite a trick to set a planer tool to cut correctly on all and every kind of work; and when you take into account the great number of times a tool has to be ground and set in a planer as compared with the milling machine, the comparison is odious.

In the milling machine the cutters are generally set by the foreman of the job, and after the machinery is warmed up he usually examines the work to see that the pieces are milled to the gauge, the boy having nothing to do with this part of the work, and therefore cannot get the work any different, while with the planer he is liable to, and generally does, get different sizes with every setting of the tool.

To wind up, I want to ask "Grumbler" to take another look at the sketches of drill press columns in the issue of Dec. 3, and see if he notices any difference in the thickness of the base under the two. I am aware that the base under every make of drill in which the table is made to revolve around the column is not nearly strong enough, but I also know positively from trial that there is not as much spring in the base as there is in the rest part if tested as explained, and I also know another thing—that in nine shops out of ten, that nine jobs out of ten are done on the drill press table, making it far more necessary to have the column and table rigid than to have the base strong and the rest of the machine weak, as most tools of this class are.

JOHN J. GRANT.

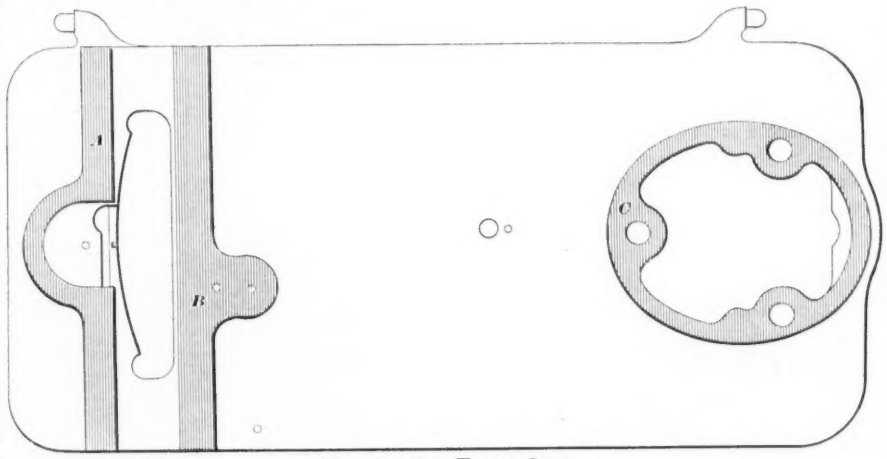


FIG. 1.—ONE-THIRD SIZE.

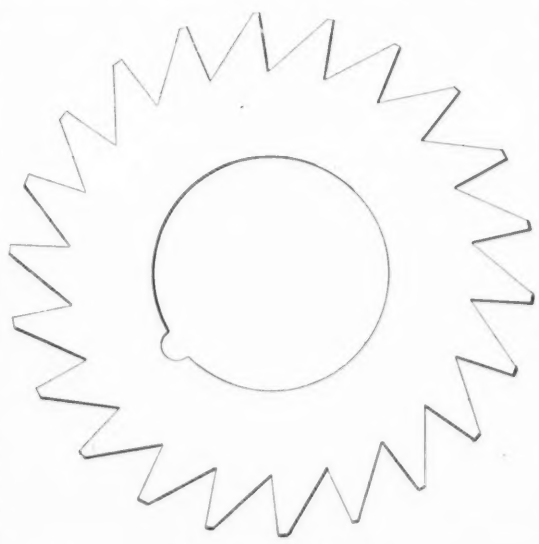


FIG. 2.—FULL SIZE.

Making Spur Wheels.

Editor American Machinist:

In connection with the communication from Mr. Bolland, on making spur wheels, in the AMERICAN MACHINIST, of Feb. 25, I would state that I have made a few and have seen a few made, but the best way to try if the segment is true to the circle is as follows: Make your bed and put in your spindle and segment on it down on the bed. Then get some flour in a clean bag and dust a little on between the teeth, and move it around, putting it down as near as you can on one of the marks left by the teeth. Follow it up all around the circle and you will see whether all the teeth will be the same size, as it is very rare that a segment of the teeth comes out right the first time.

THOMAS WATHEY.

Setting a Lathe to Turn Straight.

Editor American Machinist:

In last week's issue, C. L., New York, asks for a simple way to set a lathe to turn straight. The answer was a sort of a cut-and-try system which hardly suits me. I have always found the following a simple and accurate way to set a lathe to turn straight: Set the tool the same height of the centers, and turn up a short distance on the shaft. Then set the tool up so that it just touches, or so that you can get a thin piece of paper between tool and shaft. Then take the shaft out of the lathe, so that the tool can be moved up to the live center; put the shaft in again, with the turned end on live center; if the tool touches the same, as on the dead center, then certainly the lathe is straight. If it does not, a little adjustment of tail stock will fix it. This is not a new idea, yet it may be new to some.

JOHN R. BECKETT.

[As our correspondent intimates, the method indicated above is a familiar one, and is very good as far as it goes. But if it is desired to set a lathe *exactly* straight, we know of no method except that given in our answer. If set by any other method we know of, close calipering will usually show that further adjustment is necessary.]

Screw Cutting in the Engine Lathe.

Editor American Machinist:

In cutting screws in a simple geared lathe, where the stud and spindle make the same number of revolutions, it is always well to know at least two rules in calculating the change gears for the same, for the following reasons:

In the AMERICAN MACHINIST of February 4th a correspondent, Mr. Foster, states as follows in rules for screw cutting:

All the latheman has to do in a modern lathe is to multiply the lead screw and the screw to be cut by the same number, and his gears will be right every time—(I am not criticising Mr. Foster's practice, remem-

ber)—but suppose that the gears $\frac{24}{48}$, $\frac{30}{80}$, $\frac{36}{72}$ are lost through some unknown means, the workman knowing only the one rule, as cited, and wanting to cut 12 threads per inch, would put aside the following remaining gears, $\frac{28}{56}$, $\frac{40}{80}$, $\frac{32}{64}$, and would be very likely to say he could not find the gears to cut 12 threads, but it can be done with the gears remaining.

Example.—Lead screw, 6 threads per inch; screw to be cut, 12 per inch. Then dividing 12 by 6 we get the quotient 2, showing the ratio between the screw to be cut and the lead screw, and which proves that the gear on lead screw must have twice as many teeth as that on spindle. (We take it for granted that we understand when the screw to be cut is finer than the lead screw, we place the larger gear in the latter, and when the screw is coarser than lead screw, we reverse the above.) If we wanted to cut 9 threads per inch, then $9 \div 6 = 1\frac{1}{2}$, and the gears $\frac{32}{48}$ will cut it, because 48 is $1\frac{1}{2}$ times larger than 32. From the above we can deduce the following rule: Divide the number of threads per inch wanted by the number of threads per inch on lead screw, and the quotient will be the ratio between the number of teeth in the gear on spindle and that on the screw.

If we have a modern lathe with a lead screw of 6 pitch, and gears ranging from 24 to 88 teeth, enlarging by 4 to 56, and by 8 to 88, and we want to cut the following threads per inch—$2\frac{1}{4}$, $2\frac{5}{8}$, $4\frac{1}{8}$, $3\frac{3}{4}$—which are not shown as a curiosity, but from actual practice—the change gears for these threads can be found from the above lot by the last mentioned rule, but not by the former. A vast number of threads can be cut with a full set of gears like those mentioned, but a table thus formed would be more of a curiosity than it would be useful, and would give practice in the use of the rule:

Multiply the pitch of the lead screw per inch by the number of teeth in the gear on the same, and divide by the number of teeth in the gear on spindle. The quotient will be the number of threads per inch cut.

Edward D. Gleason.

By a Principle of Hydraulics.

Editor American Machinist:

For the benefit of those of your readers who are using the old style lathes with solid spindles, I send the following from my experience in getting out an old center which was too short at both ends and was thoughtlessly put in. After trying every thing suggested by "old hands," except taking to the forge and heating, I finally hit upon a plan which did the work very effectually.

The center did not reach the drift hole, and did not project from the spindle sufficiently to get hold of it with anything which would draw it out.

I tapped out one side of the drift hole with an ordinary blacksmith's taper tap, any size I could get to enter the hole. Into this I screwed a plug which was made of round iron with a slightly taper thread on one end; this was screwed in tight. I then fitted a straight plug into the other side of the drift hole, and made it just large enough to go in without sticking. I then filled the drift hole with oil, and, inserting the straight plug, struck it a couple of quick sharp blows with a hand hammer. This forced the center out, as by means of hydraulic pressure. Both plugs can be made long enough to extend to the outside of the cone gears, and all work can be done without removing the spindle from the lathe. If the spindle has an oblong slot in place of the round drift hole, make the plugs of such a shape as will closely fit the slot, and hold the lower one by means of a clamp or wedge, so that it can stand the force of the hammer blows. As it required only about twenty minutes to do the job, and no damage to the lathe spindle, it is certainly worth trying to anyone who finds himself in this kind of a scrape.

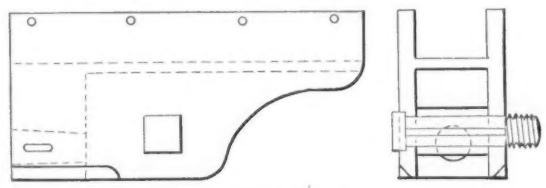
Chattanooga. C. P. W.

[Of course it is to be sincerely hoped that not many mechanics will find themselves in such a scrape, but the principle involved might often be made use of under various circumstances with great advantage.]

Mogul Cross-Heads.

Editor American Machinist:

The sketch will show a way we adopted for holding the pin in mogul cross-heads. The pins were forever getting loose and breaking the feathers that held them from turning. The thimble being so much larger in diameter than the pin, a little hand-keying would introduce sufficient friction to wrench the feathers off. Considering the way a cross head pin wears, this is something not easily avoided.



Mogul Cross-Heads.

To remedy this we squared out half through the stock on one side, so as to leave a head on the bolt nearly as large as the thimble. Then the heads of the steel bolts were fitted with care, and those so fitted eight years ago have never shown signs of working loose.

Why is it that builders of locomotives do not put in larger cross-head pins—say instead of three inches, make them four inches? I don't think a slight shortening of the rod would make any material difference.

Another abomination is the round-ended box. It is forever rolling in the strap and wearing it out of shape. If the front boxes were made in shape like the back ones, and the cross-head pins made larger, I think it would be an improvement. I never saw a front end that I did not think wore three times as fast as it would if made as large as it should be. Engineer.

Becoming Locomotive Engineers.

Editor American Machinist:

T. M. Banks speaks with good judgment in regard to becoming a locomotive engineer. It is not those who have served their time in the machine shop and reading that make the best locomotive engineers, but those who have served three or four years as firemen, and those who have been close observers and are thoroughly acquainted with the handling of all classes of trains, and capable of making the best time; those are the men that the master mechanics promote to the right-hand side of the locomotive.

Take an engineer off his engine and put him in the shop on a planer or lathe, and see how much work he can do in a day; at the same time put a machinist on a passenger engine and let him start out on time with a train, and see how he will get along. I think he will fetch up late, with a lot of well shaken up passengers. A man should never be allowed to run an engine on any road without having fired two or three years, in order that he may have learned all the advantages of handling trains, and the general rules of the road.

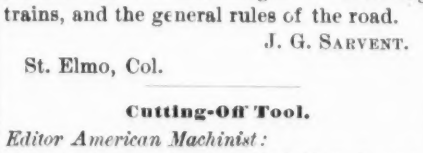
J. G. Sarvent.

St. Elmo, Col.

Cutting-Off Tool.

Editor American Machinist:

In the issue of Feb. 4, 1888, E. F. Bengler illustrates a cutting-off tool. Herewith I send a sketch of one I made for a turret lathe, after having a patent one spoilt by the carelessness of the man using the machine. I made it to fit the blades of the patent cut-off tool, which were $\frac{1}{2}$" wide. I took tool steel, $\frac{1}{2}$" x $\frac{1}{2}$", dressed it up on shaper, making it about $\frac{1}{32}$" scant one way; then, taking a screw-slotting saw, of the same thickness as the blade, with the milling machine, I soon had a holder that saved the breaking of the blades, held perfectly firm and rigid, as blade was supported almost its full width, leaving about $\frac{1}{32}$" space between the pieces of the holder, so as to get grip with tool-post screw. It was the cheapest and best I ever saw.



Cutting-off Tool.

C. E. Chandler.

Loose Pulley Device.

Editor Am. Machinist:

Did you ever doubt the originality of one of your own ideas? I have an idea for a loose pulley, the originality of which I doubt very much, but send you a sketch of it nevertheless, in case there should be something in it of interest to your readers.

Any simple device that would avoid the evils of the old construction of loose pulleys would be a boon to machinists and manufacturers. When the pulley turns on the shaft, as in Fig. 1, the diameter of its bore enlarges until the surface of contact is merely a theoretical line, as at *A*, pressing out the lubricant, grinding the shaft and getting out of true generally.

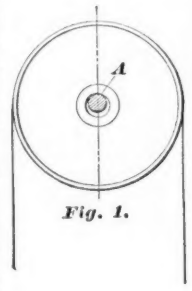


Fig. 1.

Fig. 2 shows a cone bearing applied to a loose pulley. *B* is a wrought-iron sleeve pinned to the shaft, with its ends threaded to receive the cone bearings *C*, which are secured by set screws *D* after they have been adjusted to the hub *E* of pulley *F*. *G* is the oil hole which enters a spacious reservoir from which the bearing surfaces are supplied by centrifugal force.

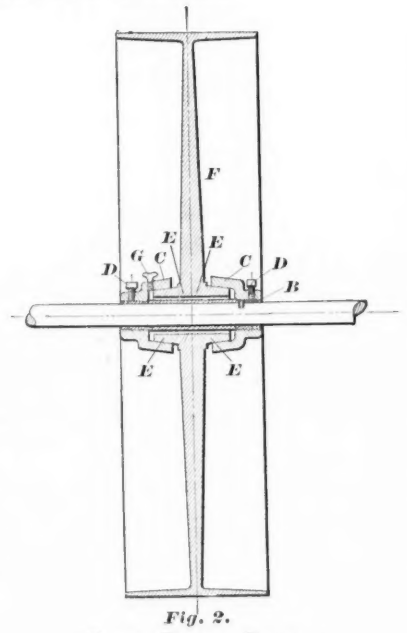


Fig. 2.

Loose Pulley Device.

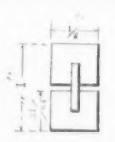
If there is anything like this already in the market, I would like to know where I can find it. Charles R. Pratt.

Boston, Mass.

Small Cupolas—Hinged Flasks—Association of Foundry Foremen.

Editor American Machinist:

If proprietors of foundries were aware of the amount of time and expense saved by having a small cupola in their foundries, I am sure there would be more of them erected than there is at present. In nearly every shop there is often occasion to run off a heat in a hurry for a break-down job, and the expense of getting the cupola ready and the fuel consumed is more than the profits on the job. In a great many country shops during the winter months times are somewhat dull, and heats are sometimes put off for four or five days, as it does not pay to run a heat for a few hundred pounds, and it is not always convenient, nor is it policy, to put a heat off so long. If they had a small cupola, in addition to their large one, many inconveniences could be overcome, and the expense for erecting one would soon be made up in the amount of fuel saved. They are especially desirable when a customer comes in with a break-down job, and must have it right off, as in a foundry nearly everything is wanted "to-day."



The firm by which I am employed have been using a small cupola for some years. They manufacture a line of goods that requires a special mixture of metal, and to obtain the results aimed at we use this small cupola. The amount of iron required for this special work is so small that it would be impracticable to melt it in a large cupola with other mixtures. The firm recently rebuilt this cupola, and I give herewith the dimensions, and some of the results:

Height from base to top of stack, 18 feet.

Height from base to charging door, 6 feet, 2 inches.

Distance from tuyeres to charging door, 5 feet 2 inches.

Distance from drop doors to tuyeres, 16 inches.

Diameter inside of shell, 28 inches; inside of lining, 22 inches.

I have 6 tuyeres, plain round, 3" diameter, but sometimes use only 2, and sometimes 4. The fan is a No. 3, and conveys the blast through a 6" pipe, and carries it about 20 feet.

I give some of the results, as follows:

Material.	Time.	Fuel.
4400	2 hours.	500 lbs. coke.
4600	2 hours.	500 " 100 lbs. coal.
4600	2h. 10m.	500 " 100 "

The material used was pig and scrap in equal parts; the metal was fairly hot.

As before stated, this cupola was built for special mixture and break-down jobs, but I use it for all heats under 5,000 pounds, unless I have a mould that requires considerable metal and hot. I have cast engine beds weighing 800 pounds from this cupola.

The saving of fuel alone will go a long way towards cheapening the cost of production. I am confident it will pay to have one around the establishment. If you don't believe it, try it.

Mr. Bolland's article in the American Machinist of November 26 is deserving of more than a passing notice. I have had some experience with hinged flasks, and my experience with them is, they are a very convenient flask. Especially is this so when flasks are too heavy to lift off by hand, and cannot, for some reason, be put under the crane. Some years ago I worked in the P. R. R. foundry at Altoona, Pa. I was moulding some covers for car wheel pits. The flasks were too heavy to lift by hand, and for some reason I could not make them near the crane, and to get the copes off I used to block up as high as the joint of the drag, then raise the cope with wedges high enough to admit a two-inch block. I would then slip a piece of 2"×3" plank, about three feet long, between the cope and drag, and let one end lay on the blocking; in this way we would roll the cope off. Had there been hinges on the flask the work would have been more easily accomplished.

R. H. Whitaker, in the American Machinist of January 21st, voices my sentiments when he says he would like to see the association of foundry foremen extended outside of the New England States. If he will send me his address I will be pleased to write to him on the subject. There is no reason why such an association should not be a success. There are plenty of questions pertaining to the foundry business that could be discussed to the advantage of many of us.

Since the above was written, I have received a copy of the rules of the New England Foundry Foremen's Association from the secretary, Mr. John P. Peso, and the objects, as set forth in this book of rules, are of such a character as should receive the support of all who may be interested in the foundry business.

Lancaster, Pa. F. B. Shaffer.

Hardening Cast-Iron.

Editor American Machinist:

I notice in your issue of Feb. 25th, a note

by Louis Kunz, on the "Hardening of Cast-Iron."

I would like to ask him how the hardness thus produced compares with that of wrought-iron case-hardened. I would also like to know whether he has had any experience as to its relative wearing capacity. I would finally inquire how the quality and composition of the iron affects its hardening capacity.

You are right in saying that it is not, properly speaking, a case-hardening process.

I should expect the composition and appearance of the hardened portion would be about the same as that of chilled iron. I should also expect that the hardening would reach deeper with hard brands of iron than with soft ones.

I regard the process as important, and an exceedingly valuable one, and to me, at least, it is entirely new. I hope Mr. Kunz will take up his pen again at an early date, to describe more in detail, the process, and the properties of the product.

JOSEPH TORREY.

Grinnell, Iowa.

An Improvised Surface Grinder.

Editor American Machinist:

We have found a new use for our cutter grinder, by which its utility is very much increased, and offer the idea for the benefit of those who may be interested. It is applicable to the ordinary Brown & Sharpe, Pratt & Whitney, Garvin or other make of grinder as made for grinding mills, reamers, and similar work.

We make it do duty as a surface grinder, and it does good work, and good looking work.

We pay no attention to how rough we mill or shape a piece of work; we get it down to size, then grind it perfect. Perfect is a pretty large word for a mechanic to use, but this comes up to the requirements, as it were. It is bound to come perfect, because it has a good principle, *i. e.*, it is not squeezed up in a chuck and hammered down flat, nor is it sprung down by clamps, but is passed under the wheel gently by the hands. No matter how large or small, thick or thin, it is bound to come out straight and parallel, for the wheel, touching all points, one after another, must necessarily bring them alike.

Strip the machine of all its attachments and leave the table bare. Lay a flat plate on the table (its own weight will hold it there—we use one about 12 inches square), and you are ready for work. Start grinding at the back of the wheel, being careful not to grind too heavy at once. Pass the work through lengthways, then crossways, then diagonally through until the wheel will not cut any more, and you will find that you have a perfect face, and nicely finished, it being spotted better than scraping could make it look. We never think of filing a piece of work now; everyone takes it to the grinder; it does not pay to file; the grinder will do it far better and quicker. There is nothing new in this, I know; but how often have I wished for something of this kind without knowing how to have it, even with a grinder standing beside me.

It is one of the machines that it is necessary to have if you have a milling machine; but I always considered it an expensive machine until we turned it into a surface grinder, and now it has a large balance to its credit on the other side of the ledger, and as it is constantly in use it speaks well for itself.

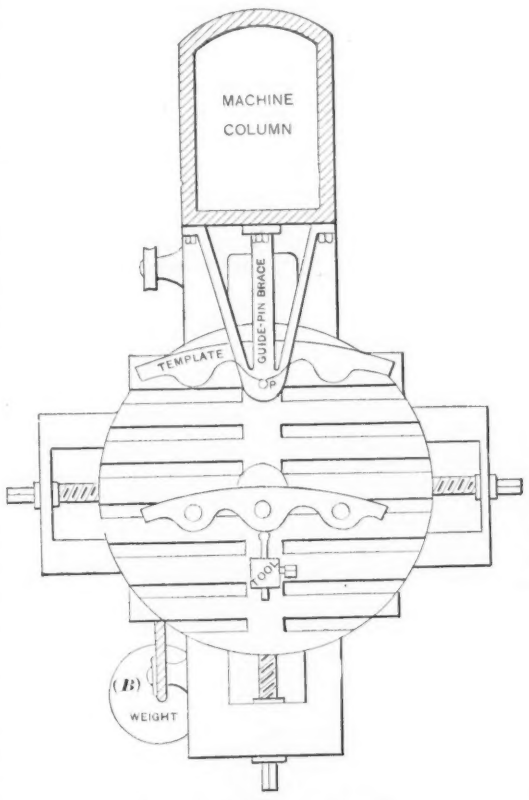
I can't say enough for it, because it fills a long-felt want.

WM. NEWBIGGING.

Profile Slotting Device.

Editor American Machinist:

In a previous number of the AMERICAN MACHINIST, my attention was called to a device for milling links and other irregular and curved work on the milling machine. After giving the matter some thought, I venture to suggest a scheme which appears to be more practicable and economical than the one mentioned. While I have not had the opportunity of giving it an actual test, yet I can see no reason why it should not prove a success. By the method I suggest it is possible to slot four link halves at one time, finishing back and front at one setting, on any ordinary slotter. The sketch accompanying will explain the arrangement. The lower feed screw will be disconnected from table, leaving movement of same to be governed by a templet, which is securely



PROFILE SLOTTING DEVICE.

bolted to one side of the table, and held against the guide pin, as shown, by a weight *B*, this being secured to the table by suitable means. This weight will be used at the back or front of table governed by the side of work to be planed. The object of this weight would be to keep the templet against the stationary pin as it is being moved from one end to the other, therefore conforming the movement of the table to contour of the templet, and transferring the same shape to the work to be slotted.

I offer it for what it is worth, seeing that all the objections which are apparent could be easily overcome. L. C. SHARP.

Air-Pump Difficulty.

Editor American Machinist:

I read in your most valuable paper of the 3d ult. a description of C. A. G.'s trouble with an air-pump. His description of the working of the pump and his results obtained from the severe tests made by him, would lead me to believe the pump did not discharge at top of cylinder, or upward stroke, causing a pound at bottom head or return stroke, as it only discharges one way. I would advise him to disconnect discharge pipe at pump, and ascertain if such is the case, by placing hand over hole and see if it discharges at both strokes. If it does not—which I am almost certain is the case—the port on the top of the air cylinder, which conveys the air from one chamber to the other, must be obstructed with some foreign matter. I have known this port to get closed entirely, causing the same trouble as C. A. G. speaks of. This is one of the many things that come under the head of happening once in a thousand times, but it will happen, nevertheless.

J. T. ROBINSON.

Richmond, Va.

What Might Have Troubled that Air Pump.

Editor American Machinist:

I had occasion to look over an air pump that acted similarly to the one described by C. A. G., in your issue of March 3. The pump was reported "bad pound and slow air." I tried the pump and found brass discharge valve seat a little loose. I tightened that and tried again; same old pound. I went all over that pump; everything was in good shape, but it worked badly when I tried it again. I took the spanner wrench and tried to tighten the piston-packing nuts; they were quite tight, and seemed in good condition, and the piston looked bright and smooth. More from habit than from anything else, I took my oil can and squirted some oil on the piston rod, when the pound stopped and the gauge began to go up immediately, and then I could easily screw the lower nut down more than one thread.

The packing evidently stuck to the piston rod on the up stroke, and did not bottom until almost at the bottom of the down stroke, and the air escaped there in such a manner that I could not detect it. A spanner wrench and an oil can might not cure C. A. G.'s difficulty, but they are easily tried, and I generally find when I get to the bottom of my worst cases something equally as simple effects a cure.

GEORGE HOLMES.

Early in the list of destructive agents that deal death to those engaged in working up saw logs, *The Woodworker* places the "exploding boiler," which, judging from the number of saw mill boilers that "let go" in the course of a year, is probably quite correct.

AUTOMATIC SURFACE GRINDING MACHINE.

Geo. O. Vair, of Wausau, Wis., sends a cast-iron cup, saucer, and spoon, cast together, just as they would appear with the cup standing in the saucer and the spoon in the cup, the whole being made from ordinary table ware for patterns. This has always been considered a creditable job for a moulder, and Mr. Vair has certainly produced an excellent casting of the kind

Automatic Surface Grinding Machine.

The engraving presented herewith is of a machine designed especially for grinding long strips accurately, and also any surface not over ten inches wide. The table has a travel of thirty inches.

The work is placed in the machine and adjusted by stop screws so arranged that the pieces are ground exactly to the proper thickness. The pressure of work on the wheel is regulated by counterweights, and any required pressure can be brought to bear on the wheel that the quality of material and finish may require.

The machine is especially adapted to grinding long strips of steel, and was brought out by the manufacturer for grinding cutters for key-seating machines and other long sirips that required accuracy.

The machine is made by W. P. Davis, North Bloomfield, N. Y.

Drawing School for Plainfield Mechanics.

The employes of the Pond Machine Tool Co., who have recently removed from Worcester, Mass., to Plainfield, N. J., were tendered a reception at the rooms of the Y. M. C. A. of the latter place, on the evening of February 29th. There was good music, vocal and instrumental, besides other forms of entertainment, including supplies for the inner man. The new residents of Plainfield were given a cordial welcome, and spent a very pleasant evening.

Prof. A. A. Titsworth, of Rutger's College, addressed the company on the subject of mechanical drawing and the advantages to mechanics of a knowledge of it, and at the close organized a class of those who wished to study it. They are to have free use of the rooms in which the reception was held, for the purpose, and the expense will be merely nominal. Prof. Titsworth will be assisted in the work by Messrs A. J. Garett and Geo. Titsworth, the latter a draftsman in the Potter Printing Press Works of Plainfield.

An Instructive Trust.

One of the most instructive examples of trusts that has so far come to light is the hollow ware trust, entered into by the management of the State prisons in four of the States. A few years ago there were several hollow ware manufacturers in the country, and a fair competition sharpened the wits of those engaged in the business, until hollow ware of excellent quality could be made and sold at remarkably low prices. The processes of manufacture were so simplified that it seemed a very nice business indeed to be carried on in State prisons, and the result was that, with labor without cost, and the resources of four great States as capital, the prisons were able to close up all outside manufacturers and get a good square monopoly of the business of making pots and kettles. Now the managers of these prisons, having done away with all possibility of outside competition, have formed the inevitable trust, through the working of which they expect to raise the price of this part of kitchen furniture. There is no reason whatever why they should not make the price about what they please; for, should some venturesome spirit see money in these prices and attempt to enter the market as a manufacturer, it would be no trouble at all to the prison management to freeze him out, and charge the cost of doing it to the States. Even the venturesome manufacturer would, himself, be obliged to assist in paying for his own discomfiture.

A Washington (N. J.) correspondent sends us an account of a 30-hour test made between egg and buckwheat coal, in which the finer coal showed an evaporation from feed of 190°, and under pressure of 65 pounds of 9.65 to 1, while the egg coal evaporated only 9.18 to 1. The boilers used are supposed to be identical. The coal burned per square foot of grate surface was about 9 pounds per hour. The per cent. of ash in the egg coal was 15.56, against 13.42 for the fine coal.

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The French Copper Syndicate.

The contemplation of recent operations in this country by the great French copper syndicate is not likely to be a very pleasant occupation for an American citizen, and especially for an American manufacturer the nature of whose business requires him to be a purchaser of copper.

This syndicate, by massing together $250,000,000 has gained control of the copper production of the entire world, not only for the present, but for a number of years to come, and is able to dictate the terms upon which a citizen of any country may buy copper, even though it may be produced in his own country or by his own neighbor.

It cannot be denied that in a general way and primarily, the natural resources of any country belong to the people who inhabit that country. And surely if there is a country upon the face of the earth, of which that is more true than of any other, it is these United States, in which all authority, and all security in the possession of property of any kind, comes from the people, and is entirely dependent upon their sovereign will. In view of this, and in connection with recent events, it becomes a pertinent question to inquire how long, and to what extent, any association of men banded together under whatsoever name, be it trust, syndicate, or what not, can expect a free people, in whom is supposed to be vested supreme authority for regulating their own affairs in the manner which seems to them best calculated to secure the greatest good to the greatest number, to support and defend a claim upon any natural resource of their country, when by the maintenance of such claim they are simply permitting themselves to be outrageously robbed and cheated out of a natural birthright?

We are as much in favor of the full protection of property rights as any one else can be, so long as the exercise of those rights does not interfere with the equal rights of others; but American factories, employing American workmen, are closing their doors and turning their men into the streets to join the army of the unemployed, as a result of the operations of this band of alien robbers—and we believe it to be the duty of Americans to see to it that such operations are speedily rendered impossible.

We can but believe that the copper of the Lake Superior region was deposited there for the use of the people of this country, and the fact of their having undoubted authority to regulate the disposal of it in the way that to them seems best, and yet allowing a company of foreigners to gain complete and absolute control of such an important product of their country, and to fix the terms upon which it shall be made use of by its primary owners, is absurd, and would be ridiculous if the occurrence and the principle which is involved in it were not likely to be burdened with such serious consequences.

Even as we write, the news comes that valuable deposits of tin have been found in Dakota, and Americans are congratulated upon the fact that no more tin will have to be imported from England, and that her monopoly of centuries is near its end. But of what benefit will this discovery be to us if some combination of foreign capitalists shall choose to gain control of the land or of its products, and thus compel us to pay more for the American tin than we now pay for the English? Under the present regime, what is to protect us from such action being taken by any combination which may be formed for the purpose in England, or anywhere else where there is sufficient money to be had.

There was a time when two hundred and fifty millions of dollars would easily have bought up all the land upon which water-power could ever be utilized in this country. Assuming that time to have been one hundred years before the discovery of the power of steam, suppose that a company of Frenchmen, or Chinamen, having sufficient capital, had invested it in that way, they would then have been able to dictate the terms upon which Americans should make use of their water-power, and at the end of the hundred years might easily have accumulated money enough to also control the production of coal when the invention of the steam engine had made its value apparent; they would thus be in absolute control of the most important sources of motive power, and could place such restriction upon the industrial development of the country as they might see fit, even to the extent of preventing us from ever becoming anything more than producers of raw material. But could the American people reasonably be expected to defend and protect such a company in the exercise of any such power? We think not. And yet, is not the principle involved in the operations of the copper syndicate precisely the same? And if allowed to go on unchecked may it not reasonably be expected to result in serious disturbances and trouble?

Americans are apt to pride themselves upon what they call the Monroe doctrine; but what, we ask, does the Monroe doctrine amount to with a people who will allow such a condition of affairs as will make it possible, and in fact easy, for any combination of foreign capitalists who may so choose, to practically lock up the natural resources of their own country and levy blackmail upon every citizen who is obliged to make use of them?

Such a condition of affairs is nothing less than a national disgrace, and the sooner it is wiped out the better.

A Case of Too Much Government.

Very rosy pictures have from time to time been drawn of the town of Pullman, Ills., and it has been regarded by many as a sort of industrial paradise, where the workman who was so fortunate as to secure employment would at the same time secure for himself all things necessary for his complete happiness.

Some years ago we expressed doubt as to the realization of the expectations regarding it, and the opinions expressed at that time are now confirmed by the fact, as reported in the papers, that the people living there are making an effort to have the place made a part of Chicago; "the monarchial nature of everything in Pullman" being given as the reason.

The fact is that men and women are not mere machines, but have varying tastes and ambitions, which they must be allowed to seek the gratification of in their own way, the same as other people.

It would seem at the first glance as though people should be happy in such a town as Mr. Pullman has provided for his employes and their families, but the fact is that no community where the expression of individual taste is repressed or prevented can ever be successful while human nature is as it is, and the fact needs to be recalled occasionally, that the human nature of workmen is very much the same human nature as is found in other people, and that they will never be satisfied to have their employers decide just what their manner of life shall be.

When a man has honestly earned a given amount of money, that amount should be paid to him in money, without any restriction as to how it should be spent, other than what the laws provide to secure the equal rights of others.

We do not in the least mean to reflect upon the good intentions of the founder of Pullman, and have no doubt but that his rule there, which is considered to be so "monarchial," is honestly considered by him to be calculated to promote the happiness and well-being of the people, but nevertheless such a social condition as is there presented is at variance with human nature as it is at present constituted.

Probably a New Society.

A few weeks since we published an article from Prof. Joseph E. Torrey, of Iowa College, giving some account of an experimental iron foundry at that college. This article has stirred up the iron workers of Iowa, and the outcome is that Wm. Ferguson, foundry foreman of the Ottumwa Iron Works, at Ottumwa, Iowa, has sent out a circular, in which he proposes to those interested in the iron business in Iowa the formation of a society of iron founders and machinists. We understand that Mr. Ferguson is receiving assurances of support. A meeting will be held at Ottumwa on March 23 and 24, the object of the meeting being, if enough are found favorably disposed, to perfect an organization of the society. It is an excellent move, and we hope to hear favorable accounts of the new society that may be.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(132) H. V. B., Newark, N. J., will find directions for making babbitt metal in the American Machinist of Oct 22, 1887.

(133) G., Centreville, Md., asks: In testing a boiler with cold water, can an ordinary steam gauge be used, or should I use a hydraulic gauge? *A.*—An ordinary steam gauge.

(134) F. T., St. Thomas, Ont., will find rules for determining cone pulley diameters in the American Machinist of Feb. 5, Oct. 15, Oct. 22 and Nov. 22, 1881; Feb. 25 and Oct. 14, 1882.

(135) X. Y., —— writes: Please inform me if there is a way of testing the horse-power which a 6 or 8 inch belt (single) can transmit. *A.*—Arrange your shafting for the application of a dynamometer which will indicate the number of horse-power transmitted.

(136) W. H., Quincy, Ill., asks: How can I make a good strong mucilage, such as is used on envelopes, or something similar? *A.*—The mucilage used on postage stamps is said to be composed of gum dextrine, 2 parts; acetic acid, 1 part; water, 5 parts. Dissolve in a water bath and add 1 part alcohol.

(137) F. B. T., Boston, Mass., asks: 1. Where can I purchase a graduated expansion cam? *A.*—Since you do not state the purpose for which the cam is to be used, we cannot answer the question. 2. What is the best method for fastening rubber to iron? *A.*—See American Machinist, Oct. 22, 1887, answer to Question 425.

(138) M. H., Wallula, W. T., writes: I always thought that a low pressure engine was a condensing engine and a high pressure a non-condensing engine. Am I right? *A.*—No These terms were formerly applied as you indicate, but have gone out of use. A high pressure condensing engine is one worked with high pressure steam, as distinguished from one worked with steam of one to three atmospheres pressure.

(139) G. W., Waukesha, Wis., writes: 1. Surface condensers are being placed on Western river boats, not for the purpose of gaining power, but to avoid the loss in time and money entailed by stopping to clean boilers every ten days—a loss that amounts to $600 per month. In your issue of Nov. 13, 1886, J. B. C. asks "if it is good practice to return the condensed water to the boiler," and you reply "prefer not to do so." If you have a sufficient reason for your preference, the Western engineer has none for placing the condenser. How is it? *A.*—J. B. C.'s question referred to stationary engines in locations where always a sufficient quantity for feeding the boiler can be obtained. In such cases it is best not to use the condensed water for feeding the boiler, as the condensed water contains too much oil and other impurities which are injurious to the boiler. Of course if a reliable apparatus is used for purifying the water, the condensed water may be returned to the boiler. As to the Western boats, it is simply a choice between two evils; and since the condensed water is considerably purer than the river water, the condensed water should be returned to the boiler. 2. What is the proper size of cylinders for a tandem compound engine to give the same results obtained from a high pressure non-condensing engine with a cylinder 14 inches x 60 inches, making 12 revolutions, cutting off at half stroke and using steam at a gauge pressure of 166 pounds. *A.*—High pressure cylinder, 13¼ inches in diameter; low pressure cylinder, 28 inches in diameter. 3. Can engines of such low piston speeds be compounded successfully? *A*—Yes, providing great care is taken in the construction of the jackets around the cylinders.

(140) A. B., Redfield, D. T., writes: About eighteen months ago we took out our old engine and replaced it with a Buckeye automatic. Since that time the boiler has been subject to constant vibrations when the engine is running. I have had one stand on which the boiler rests moved; it formerly stood under the extreme rear

end. I moved it forward to the next seam and had a solid pier built for it. The front end rests on a cast-iron front. The boiler is 54 inches in diameter and 16 feet long, shell 5-16 iron, double riveted, each course being in two pieces, so that there is a seam on each side. There are forty flues 4 inches in diameter. The circulation appears to be good. The steam pipe to engine is 3½ inches in diameter, and leads off at an angle of 30 degrees from the boiler. Steam is taken from the top of a dome about 26 inches x 24 inches. There is one brace under the steam pipe about 8 feet from the engine, and 12 feet from the boiler. The engine is 11 inches x 22 inches and makes 126 revolutions. We are using steam at 75 pounds per square inch, and do not have to fire hard. I would like to have an explanation of this action of the boiler, and would be glad to receive any suggestion which will enable me to stop the vibration of the boiler. I would say that with our old engine there was no such action, although we used more steam than we do now. *A.*—The cause which leads to the vibration of the boiler lies in the fact that your new engine is a quick cutting-off engine, whereas your former engine, we have every reason to believe, was an old plain slide valve engine cutting off steam very slowly. Cutting off steam suddenly as you do now, thereby causing at regular intervals sudden stops in the flow of steam, must react on the pressure in the boiler and cause it to vibrate unless it is securely embedded on a good foundation. If you will examine the cast-iron boiler front which supports one end of the boiler, and the cast-iron stand at the other end of the boiler, you will probably find that one or the other, or both, are not thoroughly embedded on the foundation, and will rock whenever a shock occurs in the boiler. Set the boiler properly on a good foundation and your trouble will disappear.

(141) **J. L. H., Plainfield, N. J., asks:** 1. Do you know of any book which treats of tool making in particular? *A.*—We do not think there is any such book published. 2. There is a solution for hardening milling cutters and tools, simply by heating and then immersing. Can you tell me what it is composed of? *A.*—Water will do this; but we suppose you mean a solution which hardens them to the right degree of hardness, without the necessity for drawing. For this purpose a great number of solutions have been proposed, and many men have gone on using them for years, attributing their success to the solution, when really they would have found upon trial that with equal skill in forging and heating they would have secured equally good results with simple water. We think skillful and careful heating has much more to do with success in tempering than any solution, and by practice the heating can be graded to produce the required degree of hardness when quenched in water. We have no faith in "tempering solutions."

(142) **J. H. Winona, Minn., asks:** 1. When does a patent expire which was granted say January 1, 1871? 2. Also upon what date did the 17 year straight law take effect? *A.*—We submitted these questions to Mr. D. P. Wright, of the patent law agency of Whittlesey & Wright, Washington, D. C., who answers as follows: 1. The term of a patent expires on the day preceding that of the same date as the date of the grant. The term of a patent granted Jan. 1, 1871, expired on Dec. 31, 1887. See Brown *v.* Goodyear, 9 Wallace, 811. 2. The seventeen year straight patent law is the statute of 1861, section 16. This act was approved March 2, 1861. 3 In overhead steam heating, where all pipes have ample drain, and it is intended to return the water of condensation to the boiler without pumping (merely gravity, the highest point of pipes being 8 to 10 feet above water level in boiler), how should the drain water enter or have communication with the boiler? Will it do to discharge or connect drain to the feed pipe? *A.*—It will not do to connect drain pipe to the feed pipe of pump, as the head of water in the drain pipe is not a constant quantity; even if it remained at a certain level in the drain pipe, the pressure due to the height of water would require a very low pressure in the boiler, which would be of no practical use except for heating purposes. The best way to return the condensed water to the boiler without pumping is to use a steam trap made for this purpose.

(143) **W. J. G., Chattanooga, Tenn.,** writes: Some time ago the wind blew rather hard, and the question of the stability of stacks was discussed. Some calculations were made regarding a stack made of boiler iron about ¼ inch thick and 75 feet high. The distance from center to center of holding down bolts is 5 feet; the stack is 4 feet in diameter There is something about the calculation I do not understand and wish you to explain. The calculation was made thus: $75 \times 4 = 300$ square feet. Greatest pressure of wind, 50 pounds per square foot, then $300 \times 50 = 15{,}000$ pounds; total wind pressure, $75 \div 2 = 37.5 \div 5 = 7.5$ feet = the leverage, which I don't understand. *A.*—The leverage is not 7.5 feet, but there is a leverage of 7.5 to 1 according to your calculation. That is to say, if a pressure of 15,000 pounds were concentrated at a point at half the height of the stack, the bolt at the windward side of the stack would bear, if there were no other bolts, a strain of $15{,}000 \times 7.5 = 112{,}500$ pounds. In practice, however, there are other conditions not named by you, which modify this. The weight of the stack, and the fact that there are other bolts, must be taken into account; then if there is a flange at the bottom, through which the bolts pass, the fulcrum is the outside of the flange, which would make the short arm of the lever equal to the distance from the outer edge of the flange on the leeward side to the center of the opposite bolt. Then 50 pounds per square foot wind pressure is probably rather high. A wind at a velocity of 100 miles per hour is supposed to exert that pressure upon a flat surface perpendicular to the direction of the wind, but on a cylindrical surface it would be only about one-half as much

(144) **C. S., ———, asks:** 1. How fast should the face of a 40 inch grindstone run to grind lathe tools, and is there any objection to driving stone off of a counter when line shaft runs too fast? *A.*—Such a stone may run at a speed of from 100 to 125 turns per minute. There is no objection to the use of a countersnaft, but unless the speed of the line shaft is much higher than common, it is unnecessary. Suppose for instance the speed of the line shaft is 400 per minute, a 24 inch pulley on the grindstone shaft and a 6 inch pulley on the line will give you a speed of 100 for the grindstone, and it is best to get a large pulley on the grindstone, to secure belt power. It should not be less than 24 inch for that size stone. 2. In cutting square thread screws, and chasing the nuts for them, should the two tools be the same size, that is, half the pitch, or must they be a trifle wider to let the nut work free? *A.*—It is customary to make the tools the same width, unless for some special reason it is desired to make the thread of the nut thicker than that of the screw, or *vice versa*. Some allowance must be made in the width of the tools for free working of screw and nut, the amount of allowance depending upon the character of the job. 3. Could a very coarse double square thread screw be cut on a milling machine? This screw is 18 inches long, 1 5-16 inches diameter, threads 5-32 inches deep, pitch one turn in 3 inches. If this can be done would it be preferable to cutting in the lathe? *A.*—Such a screw can be cut in the milling machine, and this would probably be the best way to do it if properly fixed for it. A square thread, however, cannot be cut with an ordinary disk cutter on the milling machine, but if the sides of the thread are slightly beveled, it can be cut in that way. If the threads must be square it would be best to use two cutters, a disk cutter for roughing out and a stem cutter for finishing. 4. In forcing compressed air through rough iron pipe, is there any way of estimating the loss of pressure in a given length of pipe by friction, the pressure and diameter of pipe being given. *A.*—Formulas are given in various engineering pocket-books for making such calculations, but are not much to be depended upon. The best way is to apply gauges and test the pressure.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Planed bevel gears. Grant, see page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Before you buy a lathe write Lodge, Davis & Co.

Before you buy a shaper write Lodge, Davis & Co.

Before you buy a drill press write Lodge, Davis & Co.

Before you buy a brass lathe write Lodge, Davis & Co.

Before you buy any machine tools write Lodge, Davis & Co.

Special drives in 2d-hand tools Lodge, Davis & Co.

See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa. Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Drop presses, punches and shears. Williams White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"How to Keep Boilers Clean." A book, mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Berryman Patent Feed Water Heater and Purifier, and the Economic Boiler Feed Pump. Benj. F. Kelley, 91 Liberty st., New York.

Nicholson & Waterman, Providence, R. I., two 48 in. horizontal boring mills; 5 in. cutting-off machines; 14, 16, and 30 in. engine lathes.

Mechanical drawing, calculations, etc., taught by mail. I. D. Boyer, 324 E. 3d st., Dayton, O.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa

Robertson's damper regulator; no diaphragms, springs or packing; the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Iron, brass and copper spooled wire is a necessity to the consumer and a great convenience to the trade. S. A. Smith, agent, 23 Canal st., Chicago, Ill.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See March 10, p 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet, illustrating pumping machinery and reports of duty trials.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 105 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

New book on gears; ask dealers in books and machinists' fine tools to send for one, or send for one yourself by P. O. note. Price, 50 cents. Address Chas. B. Long, M. E., Worcester, Mass.

Special facilities for manufacturing of all kinds of light hardware and novelties by contract or otherwise; presswork and stamping done on short notice. Acme B. H. Att Co., Limited, 74 5th ave., N. Y.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue E. & F. N. Spon, 35 Murray st., N. Y

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding; if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

MANUFACTURES.

A project is on foot to start a woolen mill at Belton, Texas.

Craig & Wilkins are enlarging their machine shops at Columbia, Tenn.

The Empire Lumber Company will build a shingle mill at Riverside, Ala.

Williams & Briggs, Meridian, Miss., will enlarge their foundry and machine shop.

The De Kalb Wagon Company has been organized to manufacture at Decatur, Ga.

It is said that the Fitchburg Railroad Company will build new shops at Troy, N. Y.

The Mobile and Navy Cove Railroad Company expect to build shops at Mobile, Ala.

The Decatur, Ala., Land and Improvement Company are interested in building a rolling mill.

The Jasper Land and Improvement Company are interested in building a foundry at Jasper, Ala.

The Blue Wing Copper Company will build reduction and refining works at Blue Wing, N. C.

The Kansas City, Memphis and Birmingham Railroad Company will build shops at Memphis, Tenn.

The citizens of Windfall, Ind., offer free natural gas to anyone who will build a roller mill at that place.

The Virginia Nail and Iron Works, Lynchburg, will increase their capital stock from $175,000 to $200,000.

The E. Horton & Son Co., Windsor Locks, Conn., manufacturers of "the Horton Chuck," are so crowded with orders that they have commenced to run a part of their works twenty-four hours per day, employing two sets of hands.

The Lookout rolling mill, of Chattanooga, Tenn., on account of the increase in orders, will shortly begin to run double turn.

The directors of the Greencastle, Ind., iron and nail mill have decided to remove the works to whatever point offers the greatest inducements.

C. H. Lucas, Canton, Maine, expects to build a foundry. At present he makes watchmakers' tools and does a general jobbing machine business.

H. K. Porter & Co., manufacturers of light locomotives at Pittsburgh, Pa., recently divided $12,000 amongst their workmen as their share of last year's profits.

Work preparatory to building the works of the Union Iron Company, at West Duluth, Minn., has been begun. The company expects to work with a capital of $1,000,000. They will erect two eighty ton blast furnaces and steel mills and rolling mills.

The Wescott Chuck Company, Oneida, N. Y., have issued an 1888 catalogue containing illustrations and descriptions of a large variety of chucks and attachments made by them. The catalogue is finely printed and illustrated, and of convenient size.

Wm. E. Holland, who has been for the past two years employed as engineer at the water-works in West Cliff, Col., has been appointed general manager the same works. Mr. Holland writes us that he will put in a few tools and run a small jobbing machine shop.

Palmer, Cunningham & Co., Philadelphia, Pa., send us a completely illustrated catalogue of tools for machinists, jewelers, model makers, engravers, carpenters, pattern makers, wood carvers, etc. They also supply belting and general supplies for nearly every mechanical purpose.

W. H. Warren, Worcester, Mass., has just placed in the Watervliet arsenal, at West Troy, N. Y., one of his large size shapers of 24 inch stroke, weighing nearly 16,000 pounds. It is to be used in the work of making guns for seacoast defense. Mr. Warren writes us that he is very busy in building shapers and radial drills.

The city of Chicago is to have new pumping engines. Five engines altogether are wanted, with necessary boilers. Nothing short of triple expansion engines, steam jacketed cylinders will be considered, but quadruple expansion engines will be looked upon with favor. Each engine must have a capacity of 15,000,000 gallons of water in 24 hours.

The Gage Tool Company, Vineland, N. J., send us a photograph of a tough looking hemlock knot, and certificates from two gentlemen to the effect that they have seen one of the Gage planes take some hundreds of cuts over this knot, and afterwards, without sharpening, the bit would cut a hair like a razor. It is a knotty story, but the attestations seem to put it beyond doubt.

New water-works, or the enlargement of existing works, are contemplated at Jamaica, L. I.; Fort Benton, Mont.; Franklin, Mass.; Storm Lake, Iowa; Havana, Ill.; Sauk Rapids, Mich.; Howell, Mich.; Hanover, Mass.; Ness City, Kan.; Riverton, Neb.; Milford, N. H.; Avon, N. Y.; Osceola, Fla.; Cuba, N. Y., Troy, Ala.; Chatham, Va.; Farmington, Conn.; Rogers, Ark.; Albany, Ga.; Americus, Ga.; Elkton, Md.; Frederick, Md.; Fayetteville, N. C.; Dallas, Tex.; Wheeling, W. Va.; Iron Mountains, Mich.; Los Angeles, Cal.; Hayward, Wis.; Watkins, N. Y.; Lenark, Ill.; Peabody, Mass.; St. Ignace, Mich.; Red Jacket, Mich.

The Fort Worth (Texas) *Gazette* has this to say of the flour mill and elevator to be built there by Cameron & Tatum: The land purchased is 175 x 184 feet, between Monroe street and Jennings avenue, fronting the railroad reservation. A switch of the Texas and Pacific runs in front of the store rooms and elevator. The elevator will be 90 x 44 feet, 70 feet high, with a ten feet storage room below. The first fourteen feet of the elevator will be of stone. The capacity will be 135,000 bushels of wheat and fifteen carloads of bran. The storage house will be of brick, two stories high, 50 x 60 feet. The engine and boiler rooms will be of brick 50 x 70 feet, one story. The mill will be 50 x 70 feet, five stories, of stone and brick. Its capacity will be 600 barrels per day. They will require 700,000 bushels of wheat and 125,000 bushels of corn every year, and will have the elevator completed in time to buy spring wheat as soon as it is on the market.

The Indianapolis *Herald* publishes an engraving of the machine shop of Benj. F. Hetherington, as it stood in that city in 1867. It has very much the appearance of a backwoods schoolhouse, with a lean-to that might be taken for a woodshed except for the smoke stack with which it is provided. Then, in contrast with this, it illustrates the present substantial shops of the firm of Hetherington & Berner, having a frontage of 170 feet on South street. The *Herald* says: In the last few months the business has been so successful and "rushing" that it has become necessary to put in new boilers and a more powerful engine, besides adding a new cupola to the foundry. The boilers are gigantic ones, arranged for heating by natural gas, which will also be used throughout the entire establishment. One of the specialties of this firm is architectural iron work, and not only many of the handsome fronts here bear the imprint of their foundry, but many are to be seen in different cities. Railroad work is another line to which they give special attention. Few manufacturers in Indianapolis have had such unqualified success as the firm of Hetherington & Berner. Their success is the result of constant work and an eye to the wants of their trade.

Machinists' Supplies and Iron.

New York, March 1, 1888

Iron—American Pig—Prices are beginning to show a little easier tendency. We quote Standard Lehigh brands at $21 to $21 50 for No. 1 X Foundry; outside brands $20 to $20.50. No 2 Foundry is quoted at $19 to $19.50, for Standard Lehigh brands, but other brands are obtainable at $[illegible] to $18.50, and Gray Forge ranges from $16 up to $17.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 1.

Wanted—A draftsman of experience. Address Ames Iron Works, 38 Cortlandt st., N. Y. City.

Wanted—At once, ½ dozen machinists; good pay; steady work. Clark Bros., Belmont, N. Y.

Pattern maker (wood or metal); skillful, exp'd. man wants steady position. Box 677, Sparta, Wis.

Situation wanted by a first-class mechanical drafts man and machine designer. O. M., Am. Machinist.

Wanted—Foreman for boiler shop in a Western city; give age, experience and reference. F., Am. Machinist.

Wanted—Ten first-class machinists on engine work; steady employment to good men. Ottumwa Iron Works, Ottumwa, Iowa.

Situation wanted by a competent draftsman with technical education; 7 years' practical experience; French and German language. R., Am. Machinist.

Situation wanted by a mechanical draftsman with one and a half years experience, graduated from a German Polytechnikum. K. H., Am. Machinist.

Wanted—Situation by foreman brass moulder who thoroughly understands trade and mixing of all kinds of brass and refining of scrap brass. Address Brass Moulder, Am. Machinist.

A foreman pattern maker to take charge of six to eight men in a locomotive works; must be experienced in locomotive work; state previous experience and wages required. P. Am. Machinist.

Wanted—A young man for tool and supply store; one that has served his apprenticeship in machine shop and has practical knowledge of tools preferred. Address, with full particulars and references. C. B., care Am. Machinist.

Wanted—Foundry foreman for general jobbing and light snap flask work; liberal salary to thoroughly competent man. Address immediately, stating experience and references, H. M. Allen, 44 W. 2nd street, Cincinnati, Ohio.

Wanted—At once, a foreman boilermaker accustomed to pulp boiler work; must be thoroughly good hand on all kinds of steam work, and a worker. Apply, stating age, salary expected, and experience, Jenckes Machine Co., Sherbrook, P. Q.

Wanted—A thorough machinist that has knowledge of steam machinery, to act as foreman of good manufacturing plant, in a city of 35,000; must take about $2,000 stock; state age and experience; fair salary will be paid. Box 85, Am. Machinist.

Wanted—A practical mechanic with from three to five thousand dollars to take an interest in a machine shop and foundry, with a good trade established; a man acquainted with the engine and boiler business preferred. Lock box 642, Malone, N. Y.

Wanted—A foreman for machine shop; one who has had experience in building portable and stationary engines and general repair work; and who can handle men to best advantage. Address, stating expectations as regards to salary, P. O. Box C, Schenectady, N. Y.

Wanted—At the Can. Loco. Eng. Co., Ld., Kingston, Ontario, foreman pattern maker to take charge of their pattern, joiners and tender erecting shop; must be an experienced pattern maker, accustomed to locomotive work. Address, stating age, experience, reference, and salary required.

Wanted—A position as superintendent or foreman by a young man who is a first-class machinist and tool maker, also a good draftsman, and has had large experience in general machine shop practice; a systematic and economical manager of men; best of reference. S., Am. Machinist.

Wanted—In an interior town, a superintendent for an engine works; must be familiar with all the grades of cheap modern engines and modern methods of producing good work cheaply; a permanent position and good salary to the right man. Address M. A. L., P. O. Box 799, N. Y. City.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Hard rubber blowing and pressing dies and machinery a specialty. E. O. Chase, Newark, N. J.

Adamantine adhesive for making steam joints; stops leaks in boilers, stops pitting. Chas. Barnes & Co., Cincinnati, Ohio.

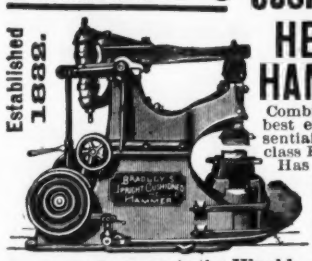
Wanted—A second-hand engine lathe that will swing 48 inch over the carriage and take in at least between the centers. Address Osgood & Barker, Bellows Falls, Vt.

Notice—The Crescent Machine Company, of Massilon, Ohio, desires to receive proposals for the manufacture of any machine or implement. Address 92 North Erie st., Massillon, Ohio.

Wanted—Wire straighteners (power preferred) for short lengths, not exceeding seven inches, Nos. 12 to 18 S. W. G. wire. Parties making such straighteners please address H. W., Am. Machinist.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1882.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the World.

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Established 1832

Pat. Aug. 30, 1887

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS PATENT VISES.

ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm hold, quick-working Lever (Not Screw) Vise. Has improved Taper Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON,
95 Chambers Street, New York.
Successors to Melvin Stephens.

MACHINE TOOLS

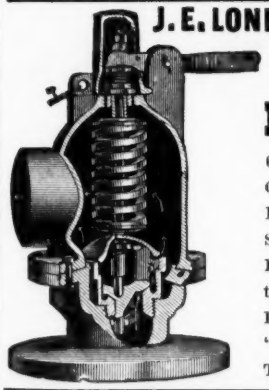
Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England.

J. E. LONERGAN & CO.



211 Race St., Phila.

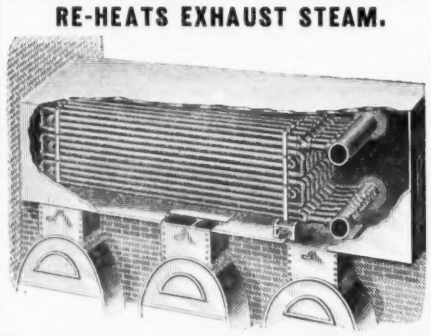
Manufacturers of

PATENT OILERS,

Cylinder Sight Feed Cups, Government Regulation Pop Safety Valves, for Locomotive, Stationary and Marine Boilers, also the "Reliable" Steam Trap.

THE HUSSEY RE-HEATER

RE-HEATS EXHAUST STEAM.



Super-Heats Live Steam, Heats Air or Water.

WITHOUT COST.

The Hussey Re-Heater and Steam Plant,

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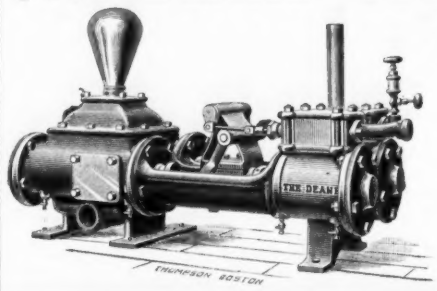
Manufacturers of

STEAM AND POWER PUMPS

FOR ALL PURPOSES.



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15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers. 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes. (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.

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DRILL RODS.

The finest stock known for small taps, reamers, punches, jewelers' tools, watch and clock parts, &c. These rods work freely, harden without cracking at low heat, and are exact in size to micrometric measurement.

All regular sizes from .013" to 1⅛" diameter in 12" and 36" lengths. Other sizes to order.

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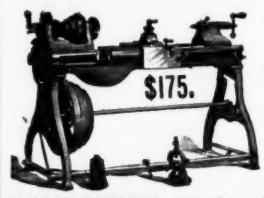
CHICAGO, ILL. PITTSBURGH, PA. NEW YORK, N. Y.



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Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

167 West Second Street, CINCINNATI, O.

OUR NEW 18 in. POWER ENGINE LATHE IS NOW READY

Exhaust Tumbling Barrels.

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SEND FOR CIRCULAR.

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RADIAL DRILLING MACHINES

THREE DESIGNS. SIX SIZES.
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
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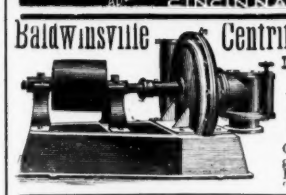

Vertical, Horizontal and Suction Pumps.

Capacity 100 to 40,000 gals. per minute. Sand Pumping Outfits e

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For Every Purpose.

Purchasers —of— McGOWAN PUMP CO. Est'd 1862

WITH BRASS REMOVABLE WATER CYLINDERS.

Send for descriptive circulars.

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For guiding twist or fluted drills, for lathe work. Will keep the drill from shifting when blow holes are in castings. Send for Circular.

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Foot and Power Lathes, Drill Presses, Scroll-saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.

Lathes on trial. Lathes on payment.

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No Dirt. No Noise. No Engineer.

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Send for Price List, mentioning this paper.

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MADE BY

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BUILDERS OF

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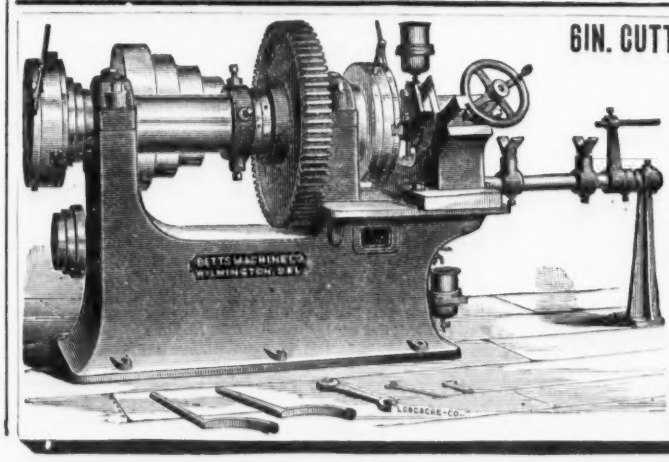

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Files and Rasps

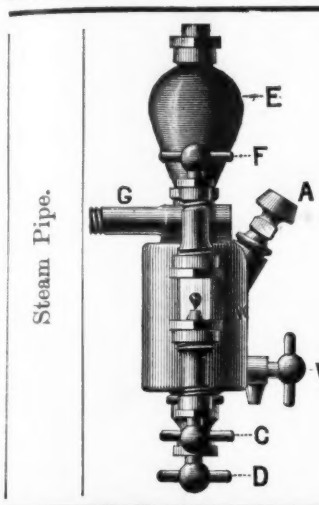
FILE BRUSH.

Having the Increment Cut.

The illustrations herewith presented exhibit more convenient and durable forms of **File Cleaners** than are usually found, the majority of those in use being rudely devised and troublesome, and we believe, for this reason, those of our manufacture will find a ready sale. Machinists and others who have not already given them a trial, will find it to their advantage to order the **File Card** and **File Brush** at once.

Manufactory and Office,

PROVIDENCE, R. I., U. S. A.



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For Stationary Engines and Pumps of all kinds. Lubricators for Single or Double Connection.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	½ pt.	½ pt.	¾ pt.

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Boiler and Pump combined.

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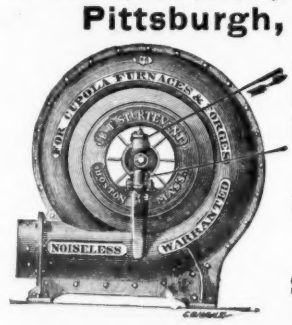

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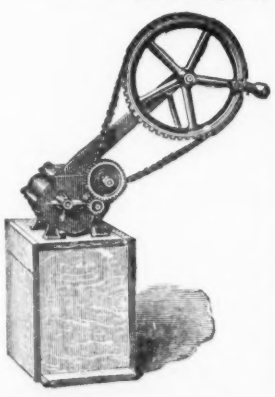

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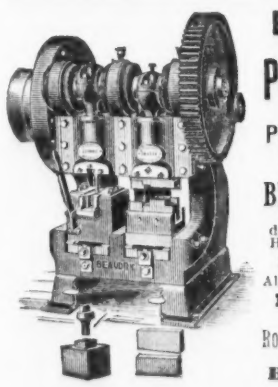
COOKE & CO., Selling Agts.,
Please Mention This Paper.



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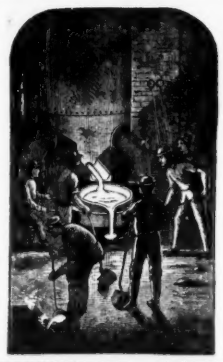

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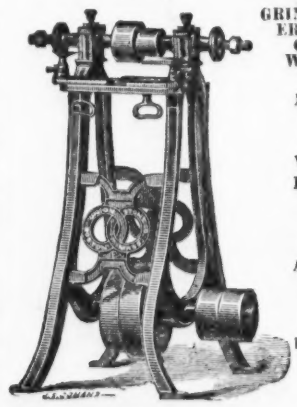

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1" Shaft. Takes Wheels to 14" diameter.
Countershaft with hangers or in machine. Is specially adapted to light work in machine shop, tool grinding, etc.

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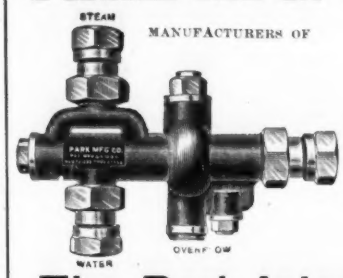

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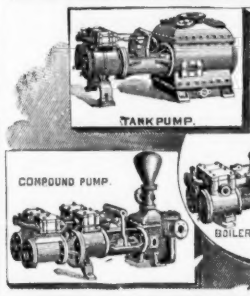

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THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.
More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.

Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.

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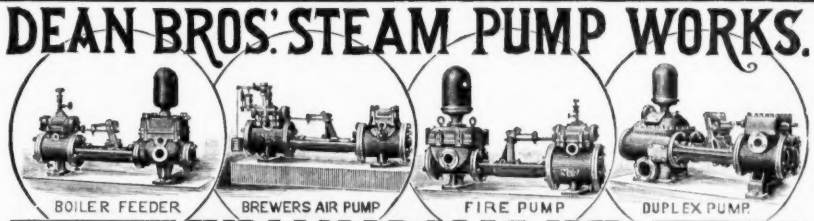

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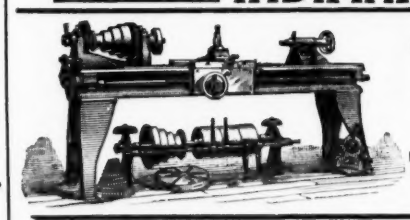

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17" ENGINE LATHES,

FOR IMMEDIATE DELIVERY.

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C. W. LE COUNT,

South Norwalk, Conn.

REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.90
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.30
Full set of 19		$33.60
20 (ext.)	6 1-2	4.00
21 (ext.)	6	5.00

This Dog has a Very Heavy Bow, so that if the thread wears, a Heavier Screw can be substituted.

With Steel Screws, Lathe Made and Hardened. When ordering, state as above, whether a full set or a set of 12, or smaller set of 6. Users of these dogs prefer them to any others made.

Le Count's Heavy Steel Dog.

One Small Set of 8—by 1-4 inches to 20 inch ..... $ 6 25
One Set of 12—by 1-4 in. to 2 in. continued by 1-8 in. to 4 in. 13 20

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TOOLS, SUPPLIES AND MACHINERY

FOR ALL BRANCHES OF THE MECHANICAL TRADES.

Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

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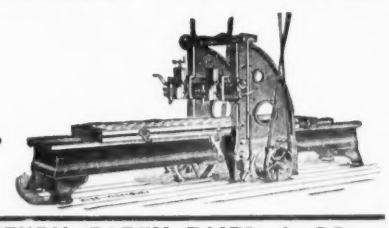
Manufacturers of

METAL-WORKING MACHINES.

Office and Works,
13 to 21 Main Street,
FITCHBURG, MASS.
Send for Catalogue (E.)



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WARRANTED Superior to any other make.

All sizes and styles of every class of work.

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BUFFALO, N.Y.

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NEW SELF-SETTING PLANE.

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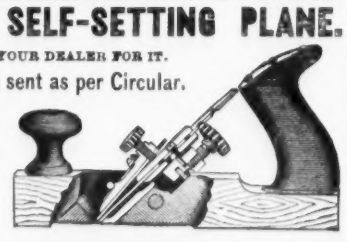

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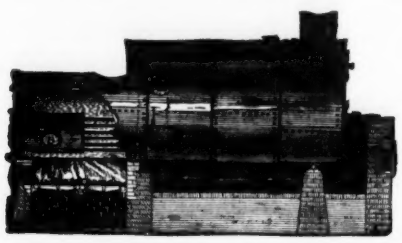

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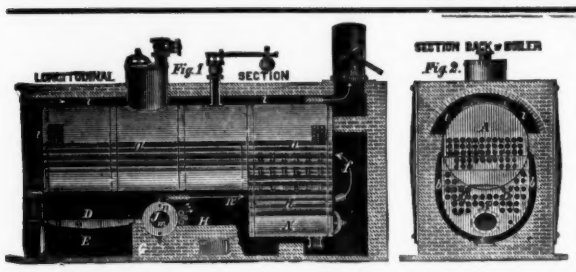

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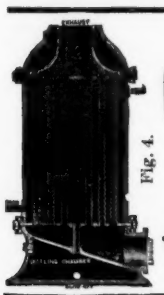

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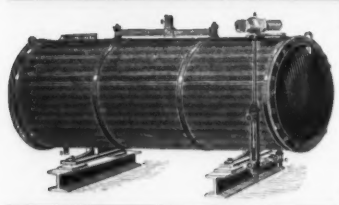

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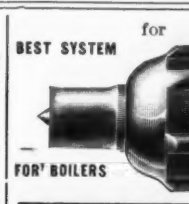

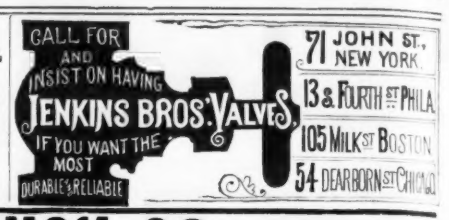

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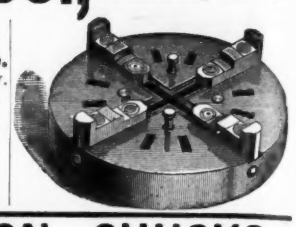

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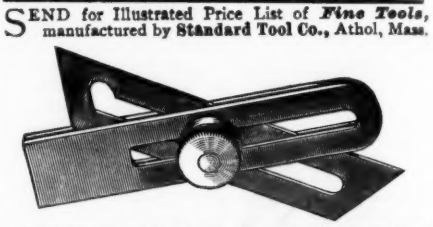

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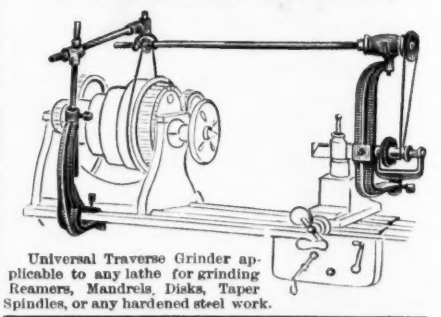

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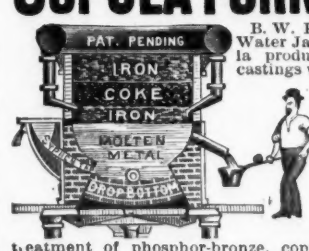

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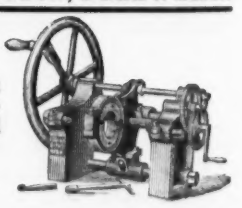

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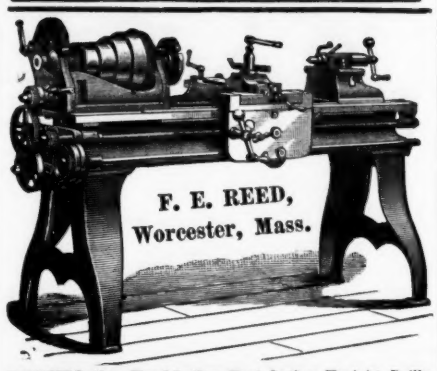

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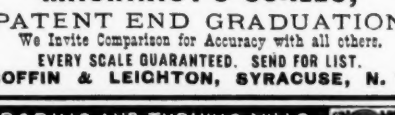

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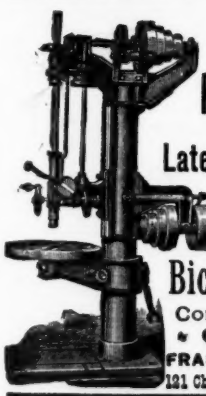

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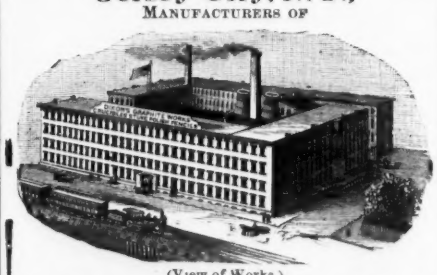

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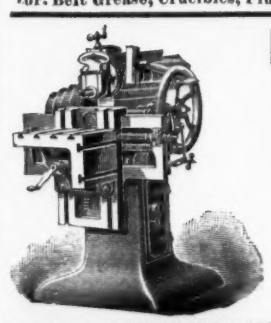

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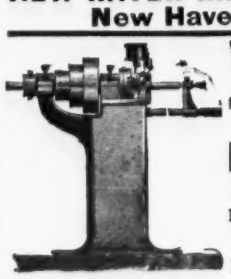

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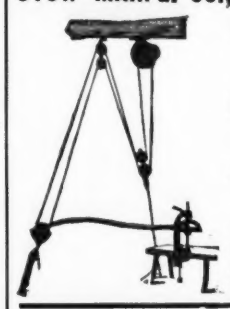

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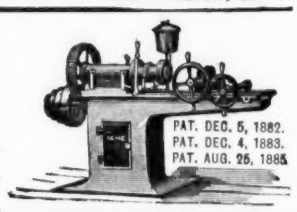

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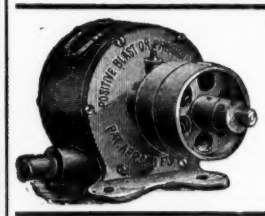

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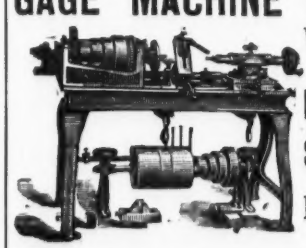

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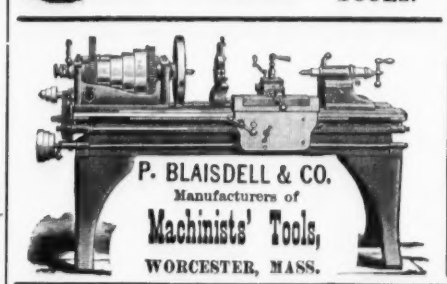

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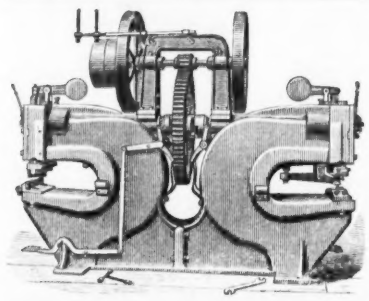

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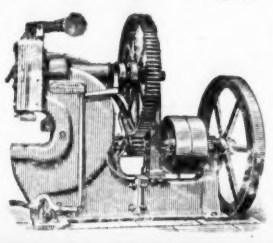

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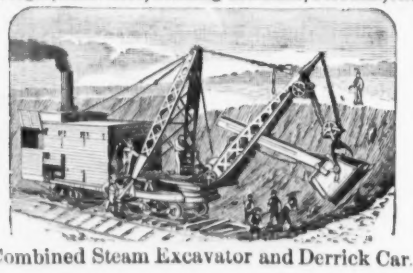

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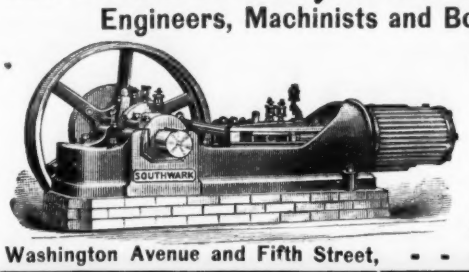

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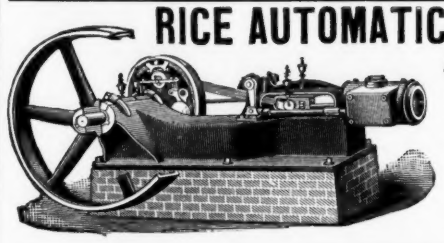

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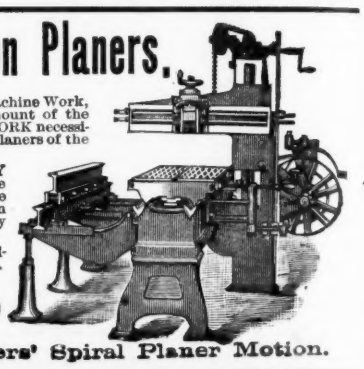

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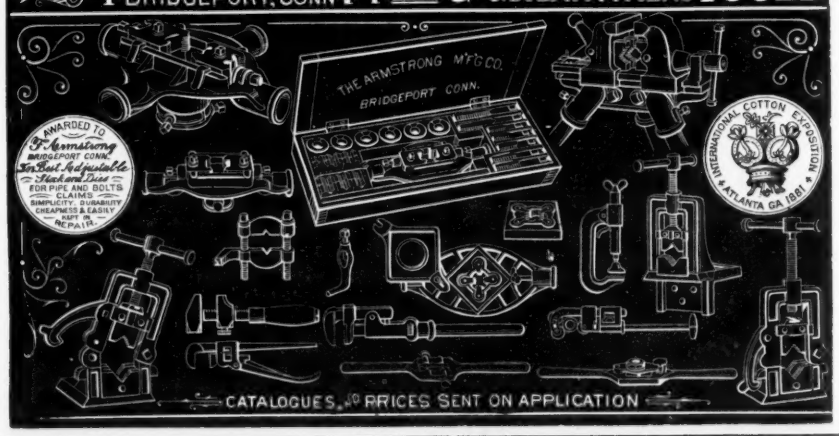
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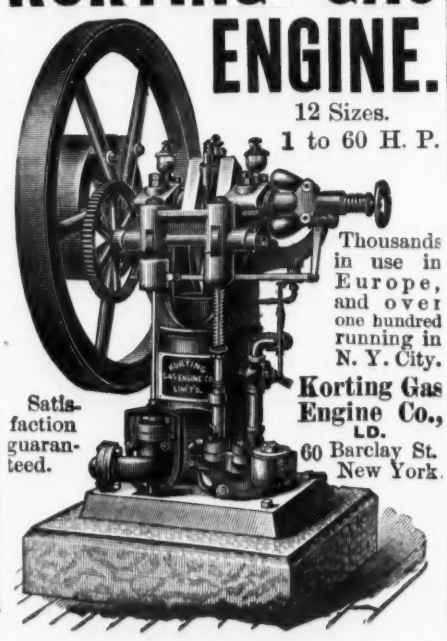

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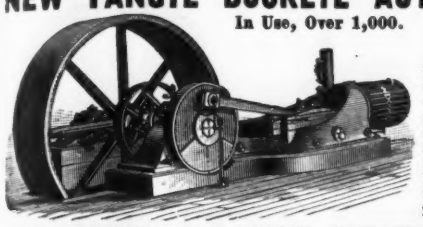

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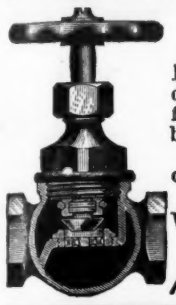

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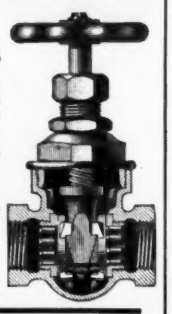

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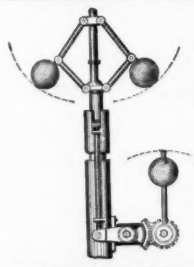

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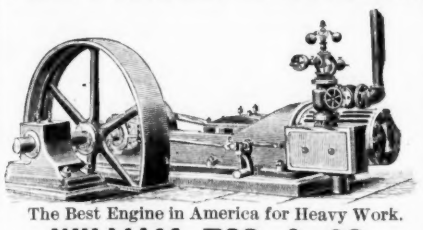

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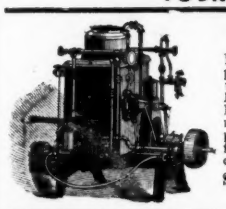

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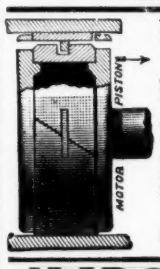

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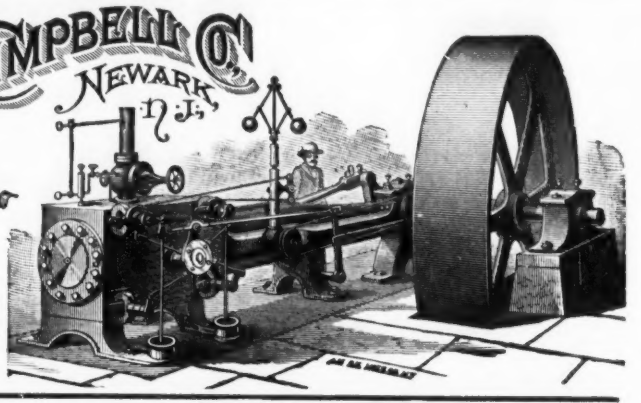

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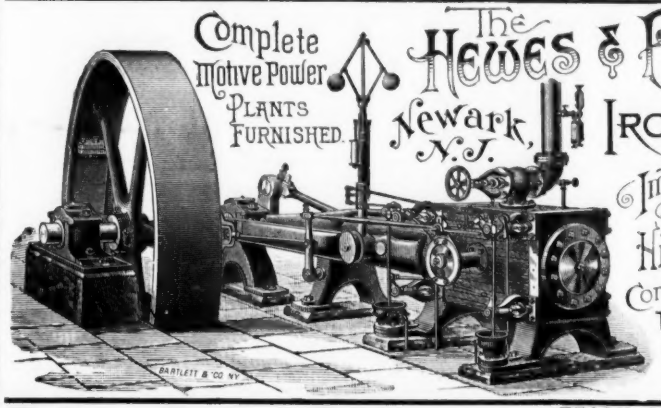

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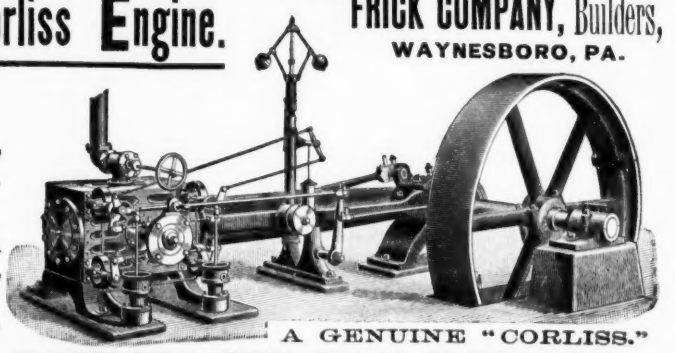

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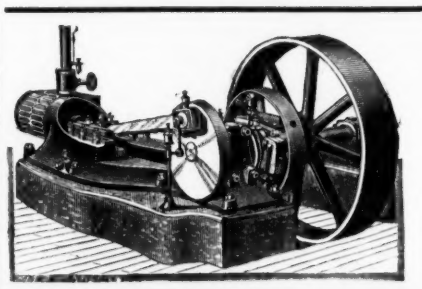

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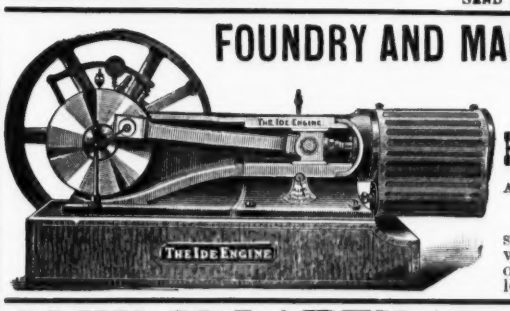

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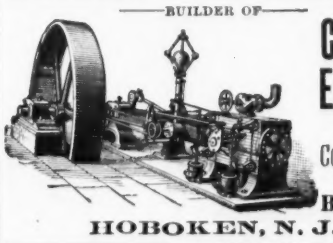

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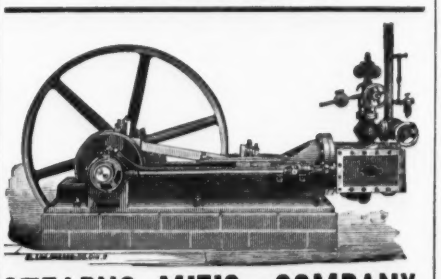

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Car Wheel Borer, 48 in. swing. Fine Condition.	
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Pratt & Whitney Vertical Tapping Machine.	

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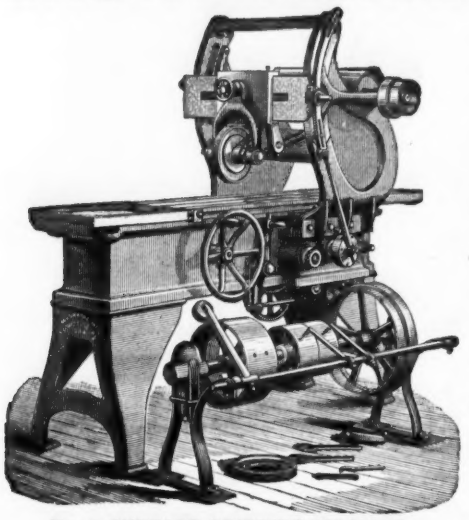

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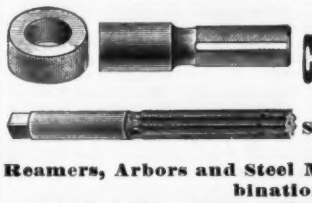

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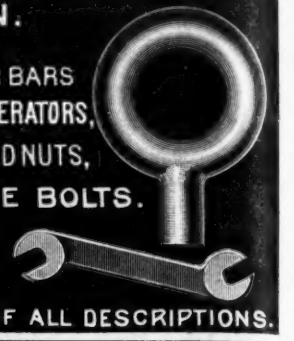

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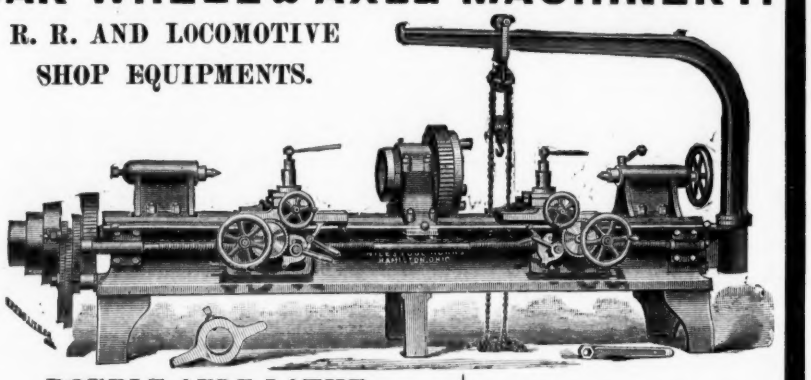

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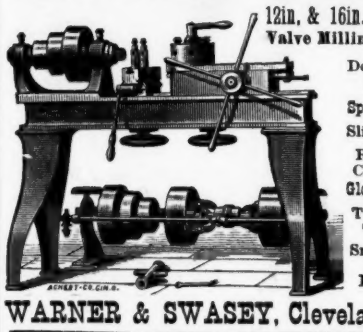

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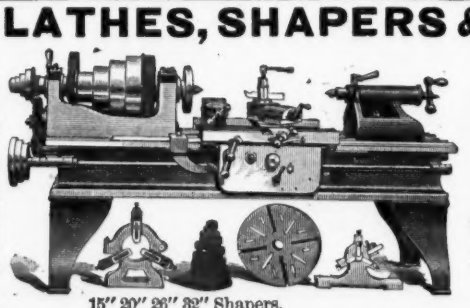

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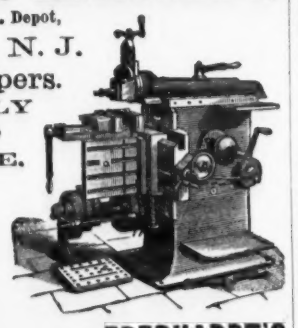

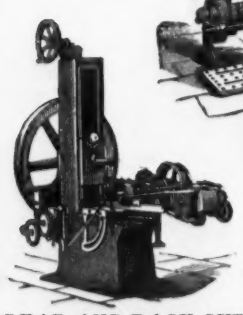

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